NOVEMBER, 1939.

GENERAL PHYSICS.

ATOMIC AND MOLECULAR STRUCTURE.

4181. Electron-Positron Field Theory of Nuclear Forces. E. P. Wigner, C. L. Critchfield and E. Teller. *Phys. Rev.* 56. *pp.* 530–539, *Sept.* 15, 1939.—A simple, spin-independent interaction is assumed between heavy particles (neutrons and protons) and electrons. Saturation of resulting forces between heavy particles is assured by choosing a bounded interaction. The change in energy of electrons in negative levels which is caused by the presence of a heavy particle is calculated. Certain general restrictions on the choice of interactions between electrons and heavy particles are discussed. [See following Abstract.] AUTHORS.

4182. Spin-Dependence in Electron-Positron Theory of Nuclear Forces. C. L. Critchfield. *Phys. Rev.* 56. *pp.* 540–547, *Sept.* 15, 1939. —An interaction between heavy particles and electrons is considered which includes a dependence upon relative spin orientation. The anomalous magnetic moments of neutron and proton can be accounted for by an adjustment of constants. Correct spin-dependence in the interaction of two heavy particles can be obtained only through an angular dependence of forces. An estimate of the angular dependence in this theory indicates that it is of sufficient magnitude for this purpose and of the right sign to give a " cigar-shaped " deuteron. [See preceding Abstract.] AUTHOR.

4183. Simple Picture of Binding Energies of H^3 and He^5. K. Way. *Phys. Rev.* 56. *pp.* 556–561, *Sept.* 15, 1939.—It is shown that an approximate application of Wheeler's method of resonating groups to the nuclei, H^3 and He^5, makes it possible to evaluate the magnitude of different contributions to the total energy. The energy expressions are separated into terms representing the internal energy of a favourable sub-group, the kinetic energy of a particle outside the sub-group, and its " ordinary " and " velocity dependent " interaction with the sub-group. For H^3 the sub-group is the deuteron and for He^5 the α-particle. The results indicate considerable polarisation of the deuteron and little polarisation of the α-particle. The total energies found were $E(H^3) = -6\cdot58$ mMU and $E(He^5) = -19\cdot51$ mMU (for the most reasonable value of one parameter since no true minimum was found for He^5). These results are compared with those of other methods. The current two-body exchange forces were used. The approximate method is quick and easy to handle. Application of the complete resonating group method to H^3, however, proved to be very laborious and difficult to make accurate. By this procedure $E(H^3)$ came out $-6\cdot68$ mMU. The smallness of the improvement over the approximate method is attributed to the fact that the complete method does not take polarisation into account. The calculated ground state energy for He^3 was $-5\cdot88$ mMU by the approximate method and $-5\cdot94$ mMU by the complete method. No bound excited state was found.

AUTHOR.

***4184. Thermal Method for Separation of Gases and Isotopes. A. Bramley and A. K. Brewer.** *Science*, 90. *pp*. 165–166, *Aug*. 18, 1939.—The apparatus described for the separation of gases and isotopes consists of two concentric vertical glass tubes, the outer one water-cooled and the inner one electrically heated. Under these conditions the tendency is for the light molecules to separate to the top and the heavy molecules to the bottom of the enclosed space. Tests have been made using a 50–50 mixture of CH_4 and NH_3 in a series of tubes in which the distance between the walls was varied from 1·3 to 22·0 mm. The gas separation rose sharply with increasing wall clearance to a rather broad maximum at 7 mm. Using a temperature difference between the walls of 350° C. a separation of 27% was obtained for this combination at a pressure of 20 mm. of Hg. Turbulent swirls within the gas are considered to enhance the separation, and it is found that poorer results are obtained with straight wire or ribbon centred tubes as well as with tubes having small clearances. Too great a clearance, however, allows excessive back diffusion. R. W. P.

***4185. Thermal Diffusion Column for Separation of Isotopes. T. I. Taylor and G. Glockler.** *J. Chem. Phys.* 7. *pp*. 851–852, *Sept*., 1939.—The construction of a 40 ft. thermal diffusion column using the Chapman effect coupled with thermal syphon action is described. The column was used to separate the various possible molecular species in methane. The abundance ratio of $C^{13}H_4$ was changed by a factor of about 2. A. J. M.

4186. Fractionation of Hydrogen Isotopes in Distillation of Ethyl Alcohol. A. H. Widiger and W. G. Brown. *Am. Chem. Soc., J.* 61. *pp*. 2453–2454, *Sept*., 1939.—It has been shown, by distillations of alcohol in laboratory fractionating columns, that the isotopic forms, C_2H_5OH and C_2H_5OD, readily undergo a partial separation on distillation, the degree of isotopic separation being comparable with that observed in the distillation of water. AUTHORS.

4187. Separation of Br Isotopes by Centrifugation. R. F. Humphreys. *Phys. Rev.* 56. *pp*. 684–691, *Oct*. 1, 1939.—Consideration is given to the high centrifugal field gradients produced by a Beams-type ultracentrifuge as a means of obtaining partial separation of relatively heavy isotopes. Approximate theory is presented for a mixture of two isotopes subjected to "evaporative centrifugation." The theory is capable of predicting the change in abundance ratio for a given set of conditions. To test the feasibility of the method Br isotopes in the form of ethyl bromide were centrifuged and the result tested spectroscopically. Br^{79} was enriched 11% relative to Br^{81}. The agreement with the predicted enrichment was reasonably good. AUTHOR.

4188. Structure of Formaldehyde from Electron Diffraction. D. P. Stevenson, J. E. LuValle and V. Schomaker. *Am. Chem. Soc., J.* 61. *pp*. 2508–2510, *Sept*., 1939.—Electron diffraction photographs of monomeric formaldehyde have been obtained using fast electrons. Their interpretation leads directly to a C–O distance equal to 1·21 ± 0·01 Å. Using this distance and the accurately known moments of inertia the C–H distance is found to be 1·09 ± 0·01 Å. and the H–C–H angle to be 120 ± 1°. AUTHORS.

See also Abstracts 4282, 4357.

COLLOIDS.

4189. Purified Pd Sols Prepared by Electric Sparking. W. Pauli, W. Hoff and F. Lichtenstern. *Am. Chem. Soc., J.* 61. *pp.* 2295–2299, *Sept.*, 1939.—Preparations of Pd sols by sparking under the solvents: conductivity water, and 10^{-3} *N* solutions of H_2SO_4, NaOH, HNO_3, KCl, HCl, are related and discussed briefly. The charging group of the sols prepared in the case of the chlorides very probably is a chlorohydroxo mixed complex of varying constitution. This complex maintains a decomposition equilibrium with molecularly disperse pallado-chloride. There are besides heteropolar groups on the particle surface that are non-ionogen and therefore not charging. These groups may react in a variety of ways. AUTHORS.

4190. Viscosity of Viscose Solutions. W. Philippoff and H. E. Krüger. *Kolloid Zeits.* 88. *pp.* 215–223, *Aug.*, 1939.—The viscosity of solutions of viscose (0·02–12%) has been determined, and flow curves have been drawn over the range 2–12%. The samples were prepared from different materials, and also differed in the ripening period. The viscosity, apart from minor deviations, follows closely that of other cellulose solutions. A. J. M.

4191. Electrolytes and Viscosity of Pectin Solutions. H. P. Kortschak. *Am. Chem. Soc., J.* 61. *pp.* 2313–2317, *Sept.*, 1939.—The viscosity of pectin sols as affected by the addition of various electrolytes has been determined. Three separate effects are present with increasing electrolyte concentrations: (a) An increase in viscosity at low electrolyte concentration, when an alkaline substance is added. This is due to the formation of the more highly ionised pectin salt from the pectin acid. (b) A decrease in viscosity to a minimum, further increase in electrolyte concentration having no apparent effect on the pectin. The formation of practically uncharged, undissociated salts of pectin is suggested, causing dehydration, and thus decreased viscosity. (c) Increase in viscosity at high salt concentration, due to interaction of the added electrolyte and water; an increase greater than this being due, in part at least, to the increased concentration of pectin with respect to water alone. Any increase in viscosity which could be ascribed to reversal of charge on addition of excess electrolyte is either absent or very small. The viscosities of solutions of pectin and of truly soluble electrolytes change in similar manner with increasing electrolyte concentration. AUTHOR.

4192. Structure of Rayon Fibre. H. Mark. *Nature*, 144. *pp.* 313–314, *Aug.* 19, 1939.—The fibre structure is considered by studying it from the point of view of its nature when studied at different magnifications, both real and imaginary.

(1) Magnification 50,000,000 times. The fundamental chemical units are observed, *i.e.* the chains of glucose residues linked together. This observation covers the chemical behaviour of the fibre, its wetting ability, swelling in water, and non-absorption of certain organic substances such as benzene, oil, etc.

(2) Magnification 5,000,000 times. The crystallographic structure is noted. The elementary cell of the cellulose lattice as revealed by X-ray analysis is observed. Long chains of residues lying parallel to each other run along the length of the fibre. Orientation of such chains, etc., explains refractivity, mechanical tenacity, anisotropy in swelling and behaviour towards substantive dyestuffs.

(3) Magnification 500,000 times. Chains of residues from (2) are bundled together. Two distinguishing parts of the fibre are evident, (a) with high crystallographic orientation and (b) amorphous. This structure thus defines strength and elasticity, the amount of swelling, dyeing ability of the fibre, and its crease resistance.

(4) Magnification 50,000 times. The fringe and net structure of cellulose is evident. The fibre may be regarded as an irregular flexible net built up of these two units, exhibiting larger holes at certain places. The mechanical properties of the thread, namely, plasticity, elasticity, tenacity and chemical reactiveness. The spaces and crevices between the crystallised portions absorb dye-stuffs, wetting agents, and other reacting substances. They are of great importance to the textile quality of the fibre.

(5) Magnification 5,000 times. Now at limit of ordinary microscope resolving power. The fibrillar structure is now evident. Morphological units are visible. The length, width, orientation of the fibrillæ are of great importance in defining the textile properties of elasticity, softness, lustre, creasability, etc.

(6) Magnification 500 times. The range of microscopic observation with ordinary light is reached. The viscose rayon thread so observed shows a system of stripes parallel to the fibre axis. Dyeing ability, lustre and appearance of the yarn are dependent thereon.

(7) Magnification 50 times. Bundle of yarn is observed and textile qualities assessed.

(8) Magnification 5 times. Ordinary familiar fibre and yarn qualities more clearly observed.

The relative importance of all phases of fibre structure are thus discussed and related. S. G. B.

4193. Particle-Size Distributions of Pigment Suspensions. S. W. Martin. *Indust. & Engin. Chem.* (*Analytical Edition*), 11. *pp.* 471–475, *Sept.*, 1939.—A method for the determination of the extent of disaggregation of pigments dispersed in aqueous and organic vehicles has been developed for particle sizes of 0·1 μ and above. The theoretical considerations of Romwalter and Vendl served as the basis for calculating the particle size distribution from a sedimentation curve obtained with a laboratory beaker-type centrifuge. Results are presented for a typical paint dispersion of a titanium dioxide pigment. To comply with industrial requirements, a rapid continuous method for the determination of size distributions from sieve through subsieve sizes is described for titanium dioxide pigment suspended in water. Illustrative data and additional possibilities for application are included. AUTHOR.

4194. Physical Chemistry of Insulin. E. J. Cohn, J. D. Ferry, J. J. Livingood and M. H. Blanchard. *Science*, 90. *pp.* 183–185, *Aug.* 25, 1939.—This paper deals with the solubility and dielectric properties of insulin and its crystallisation with radioactive zinc. The high state of purity and unusual chemical stability of insulin make it a very suitable protein for quantitative physical chemical studies. The present experiments indicate that none of the radioactive zinc introduced into insulin is removed at neutral reactions by electrodialysis or prolonged dialysis, but that at the isoelectric point of insulin the radioactive zinc is quantitatively lost to normal horse serum. When, however, insulin containing two atoms of radioactive zinc per mole was separated from serum at neutral reaction, by precipitation with the protamine, salmin, the resulting precipitate retained 0·14 % of radioactive zinc, corresponding approximately to a mono-radioactive zinc insulin protaminate. H. H. Ho.

4195. Interaction of Two Colloidal Particles, Based on the Complete Debye-Hückel Equation. S. Levine. *J. Chem. Phys.* 7. *pp.* 831–848, *Sept.*, 1939.—An approximate method of calculating the mutual electrical energy of two colloidal particles has been developed based on the original Debye-Hückel equation in the theory of electrolytes. Only binary electrolytes (symmetrical type), however, have been considered. The final expression for the energy is of the form $(Q_0^2/Da)\{f_1(R/a,\ \kappa a) + (Q_0/Da)^2\ (z\epsilon/kT)^2 g(R/a,\ \kappa a)\}$ or $\zeta^2\ Da\ (1 + \kappa a)^2\ \{f_1(R/a,\ \kappa a) + \zeta^2\ (z\epsilon/kT)^2 G(R/a,\ \kappa a)\}$, where Q_0, a and ζ are the charge, radius and electrolunetic potential, respectively, of each particle, R is the mutual separation of the two particles, κ the characteristic quantity in the Debye-Hückel theory, being proportional to the square root of the electrolyte concentration, z–z the valency type of the binary electrolyte, D the dielectric constant of the solution, T the temperature, ϵ the electronic charge and k Boltzmann's constant. The coagulating powers of the 1–1, 2–2 and 3–3 valency types of electrolytes have been studied in detail and qualitative agreement with experiment is obtained. The stability of a sol is found to be sensitive to changes in the ζ-potential, which is important for the comparison of the relative precipitation values of the different electrolytes. The distinction between the monovalent ions which coagulate at high concentrations and high potentials and the other ions which precipitate at lower potentials and smaller concentrations is emphasised. H. H. Ho.

4196. Electro-Optical Effect in Certain Viruses. M. A. Lauffer. *Am. Chem. Soc., J.* 61. *pp.* 2412–2416, *Sept.*, 1939.—It has been found that solutions of tobacco mosaic virus, aucuba mosaic virus, and potato latent mosaic virus exhibit the Kerr electro-optical effect. In dilute solutions in an alternating electric field of 60 ∼, the double refraction of tobacco mosaic virus appears to be positive for all values of the field strength, but for more concentrated solutions the effect becomes negative in weak electric fields, passes through an inversion point for stronger fields, becomes positive for still stronger fields, and finally attains a maximum value. The inversion point occurs at higher field strengths in more concentrated solutions. By bringing the virus nearer its isoelectric point, the negative effect is generally increased and the inversion point is shifted to stronger fields. Ageing the virus has a similar effect. In an attempt to explain these observations, it was suggested that two opposing forces control the orientation of the particles. One of these may be a negative orienting effect which varies with the first power of the field strength and which does not follow the alternations of the field. Opposing it and eventually overcoming it in strong fields, there was assumed to be a positive orienting effect, perhaps due to a permanent dipole moment, an effect which varies with the second power of the field strength, but which does follow the alternations of the field, and which is, therefore, affected by interparticle attraction. AUTHOR.

4197. Electrophoretic Studies of Wool. A. M. Sookne and M. Harris. *Bureau of Standards, J. of Research,* 23. *pp.* 471–477, *Oct.*, 1939.—A new investigation of the electrophoretic properties of wool shows that phthalate ion, used in buffers in earlier work, exhibits a specific ion effect, and shifts the isoelectric point to lower pH values. In acetate buffers, the isoelectric point of wool scales and cortical cells was found to be at pH 4·5. Samples of ground or powdered wool show an isoelectric point at pH 4·2. Much of the confusion which exists concerning the location of the isoelectric point has arisen from the assumption that the isoionic and isoelectric points are identical. The significance of both of these points in wool processing is discussed. AUTHORS.

*4198. **Methods of Measuring and Regulating Speed of Ultracentrifuge. Y. Björnståhl.** *Rev. Sci. Instruments,* 10. *pp.* 258–269, *Sept.,* 1939.—In the first part an account is given of the methods, tried in the Laboratory of Physical Chemistry, Upsala, for measuring the speed of the ultracentrifuge. The methods can be classified according to the nature of the primary indicator, which may be of optical or of electrical design. In the first case (optical methods) the stroboscope and a photo-cell device are considered. In the second case an electrical indicator of the following type has been designed and constructed. A part of the rotor shaft has been magnetised in a radial direction and a stator is mounted in the centrifuge casing. The frequency or the e.m.f. of the power produced by the indicating generator is measured by means of different methods. The oscillograph, different resonance circuits and bridge circuits have been considered. In the second part a description is given of a device for the automatic regulation of the speed of the ultracentrifuge. The frequency from the indicating generator is connected to a bridge. The output voltage from this is applied to a phase reversing bridge, which controls the oil supply to the centrifuge turbines by means of relays. AUTHOR.

See also Abstracts 4199, 4210, 4238, 4316, 4370.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

4199. **Disperse Structure of Solid Systems. D. Balarew and N. Kolarow.** *Kolloid Zeits.* 88. *pp.* 161–171, *Aug.,* 1939.—The many changes in the structure of a crystal system which occur under various conditions are shown to be reversible by two different sets of experimental data based on heating curves and on an emanation method. In these cases, therefore, the structure of the crystal system may be regarded as that of an intergrain conglomerate to which fundamental thermodynamics may be applied. These conclusions are then extended to the basic problem of colloid chemistry, viz., the universal character of the colloidal state and the special stability and behaviour of disperse systems, for which an interpretation is now given based on thermodynamic conceptions. Further, the various facts and observations of the emanation method have been given a new interpretation based on the theory of the disperse structure of solid systems which deviates from previous ideas on the subject. Finally, the above representation of the structure of a crystal system is confirmed from reactions conducted in the solid state. H. H. Ho.

4200. **Effect of High Pressure on Order-Disorder Transformation in Alloys. T. C. Wilson.** *Phys. Rev.* 56. *pp.* 598–611, *Sept.* 15, 1939. —With electrical resistance as an index of degree of order, the behaviour of the order-disorder transformation under high hydrostatic pressure has been investigated with the three alloys, CuAu, Cu_3Au and CuZn. Measurements were made under pressures up to 10,000 kg./cm.^{2} and over the temperature range 50° to 426° C. For temperatures below the critical point the course of the transition under pressure may be predicted from reported thermal expansion data and deductions from the Bragg-Williams' theory. The observed behaviour of the alloys seems to be consistent with these predictions. Measurements made near the critical temperature with the alloys CuAu and Cu_3Au show that the critical point is raised by pressure in both cases. One alloy, α-brass (Cu_3Zn), not hitherto included in the class of the three alloys above mentioned has been examined. The conclusion is reached that a slight ordering of the constituents of the alloy occurs under high pressure. AUTHOR.

4201. Structure of Alloy MnBi. R. Hocart and C. Guillaud. *Comptes Rendus*, 209. *p.* 443, *Sept.* 4, 1939.—MnBi is hexagonal with a 4·3$_0$, b 6·1$_2$ Å, 2MnBi in the unit cell, and the shortest distances Mn–Mn and Mn–Bi respectively 3·0 and 2·9 Å. C. A. S.

4202. X-Ray Study of Ageing Cements. E. Couillaud. *Comptes Rendus*, 209. *pp.* 397–399, *Aug.* 21, 1939.—Powder diagrams were taken of various samples of four different hydraulic cements after exposure to temperatures up to 70° C., for times varying from a few hours to 90 days; 3 cements, which harden with age at all the temperatures used, showed distinct crystallisation of which the initial rate only depended on temperature. The fourth cement, containing Al, softened quickly when treated at 45° or more. Here the diagrams showed new lines only at these temperatures; the pattern found is identical with that of the compound Al_2O_3, 3CaO, $6H_2O$ to the formation of which the observed reduction in mechanical strength is apparently due. L. E. F.

4203. X-Ray Studies of Compounds in the System PbO-SiO$_2$. H. F. McMurdie and E. N. Bunting. *Bureau of Standards, J. of Research*, 23. *pp.* 543–547, *Oct.*, 1939.—X-ray diffraction powder patterns were made on various compositions in the system PbO-SiO$_2$ in order to check the presence of certain reported compounds. It was found that three binary compounds exist: PbO–SiO$_2$ (same as the mineral alamosite), 2PbO–SiO$_2$, and 4PbO–SiO$_2$. The latter occurs in at least two polymorphic forms. The powder patterns of the α and β forms of PbO are also given. AUTHORS.

4204. Method of Producing Long Single-Crystal Al Wire with Any Desired Crystallographic Axis. T. Fujiwara. *Hirosima Journ. Sci.* 9. *pp.* 227–231, *Aug.*, 1939. *In English.*—A method of producing a long single-crystal wire of metal with any desired crystallographic axis orientated in the direction of its wire axis, by submitting it to mere annealing, without any melting, etc., has been devised by the author, who here describes his method. AUTHOR.

***4205. Splitting of Mica (Muscovite) for Optical Purposes. F. E. Wright.** *Am. J. Sci.* 237. *pp.* 736–741, *Oct.*, 1939.—The cleavage of muscovite into thin sheets and strips, free from scratches and of uniform thickness, is not an extremely difficult task, if certain precautions are observed. Tests of various methods for this purpose have led to the adoption of a method based on the use of a special needle, of spatulas of soft wood, and of strips of mica with bevelled edges and not over 4 cm. wide and 10 cm. long. With care and patience it is possible with this method to obtain strips of mica suitable for use in optical instruments and of any prescribed phase angle, or thickness in excess of 1·5μ. A convenient arrangement of the petrographic microscope is described for the accurate measurement, by means of the Friedel method, of the phase angle of a mica plate or foil. AUTHOR.

See also Abstracts 4346, 4403.

DENSITY.

4206. Dioxane-Ethanol System. R. N. Hopkins, E. S. Yerger and C. C. Lynch. *Am. Chem. Soc., J.* 61. *pp.* 2460–2461, *Sept.*, 1939.—

Density, refractive index and viscosity data for the dioxane-ethanol system are presented. The viscosity curve apparently passes through a minimum in the vicinity of 50% dioxane. Boiling points and the boiling point-composition diagram for the dioxane-ethanol system are determined. A minimum boiling temperature of 78·13° is observed at 9·3% dioxane.

DIFFUSION AND OSMOSIS.

4207. Osmotic Pressure Measurement by Isothermal Distillation. K. Hess and L. A. Surányi. *Zeits. f. phys. Chem.* 184. *Abt. A.*5. *pp.* 321–346, 1939.—After a short consideration of the porous plate method of measuring the osmotic pressure, the isothermal distillation method is described in some detail, including the temperature effect, pressure effect and the distillation velocity. The influence of the wall of the containing vessel and of the plate are discussed together with the accuracy of the results. An account is given of measurements on cane sugar comparing membrane, cryoscopic, ebullioscopic, and isothermal distillation methods. Experiments have also been carried out on the following organic substances and the osmotic pressure-concentration graphs are given :—$C_{18}H_{32}O_{16}$, $C_4H_6O_2N_2$, $C_{12}H_{25}O\cdot SO_3Na$, $(C_{12}H_{25}O\cdot SO_3)_2Zn$. E. H. D.

See also Abstracts 4184, 4185.

ELASTICITY AND PLASTICITY.

4208. Flexure of a Rectangular Covering Slab Elastically-Fixed by its Four Sides. S. A. Savin. *J. Math. Phys.* 18. *pp.* 239–255, *July*, 1939.—The flexure of a homogeneous rectangular covering slab bent under its own weight and subjected to uniformly distributed loads over its upper and lower horizontal surfaces, the four lower horizontal edges of the slab being fixed, is discussed mathematically. Expressions are derived for the displacement, cubical dilation, normal and tangential unit stresses, the support moments and the deformation of the median plane.

J. S. G. T.

4209. Magnitude of Direct Stress in Beam of Fixed Span. R. J. Cornish. *Phil. Mag.* 28. *pp.* 481–487, *Oct.*, 1939.—The direct stress in a beam of fixed span is examined for two types of loading combined with two types of end restraint. General equations are deduced for each case, and it is shown that, with beams of steel and reinforced concrete as at present designed, the direct stresses are small in comparison with those due to bending. AUTHOR.

HYDRODYNAMICS AND AERODYNAMICS.

4210. Motion of Cylindrical Particles in Viscous Flow. R. C. Binder. *J. of Applied Physics*, 10. *pp.* 711–713, *Oct.*, 1939.—Experiments were made on the orientation of cylindrical particles in viscous flow. Particles were immersed in a moving fluid between two concentric cylinders. Tests showed two different final orientations : (1) a position perpendicular to the plane of the undisturbed flow, and (2) a position parallel to the velocity direction. The relation between the final orientation and the length-diameter ratio of the particle was found for different speeds. Comparison is made between the experimental results and theoretical predictions. AUTHOR.

KINETIC THEORY OF MATTER.

See Abstracts 4329, 4356.

LENGTH, AREA AND VOLUME.

4211. Survey of Methods and Apparatus for Micro-Gas Analysis. H. Hartridge. *Journ. Sci. Instruments*, 16. *pp*. 317–324, *Oct*., 1939.—The methods of micro-analysis described in this paper depend on simple chemical and physical principles and much ingenuity has been expended on their development. The volumetric methods are subdivided under (*a*) those in which the confining medium is Hg and solid reagents are employed, the gas being measured all the time as " dry " gas; (*b*) those in which Hg or some other fluid is the confining medium, fluid reagents being employed and the gas being measured saturated, or partially saturated, with aqueous vapour; (*c*) those in which the confining liquid acts as a flotation medium for a small gas-containing vessel or " diver," fluid reagents being employed and the gas containing aqueous vapour; (*d*) those in which there is no confining fluid and the pressure of the gas is measured by a physical method, *e.g.*, the mica-plate method. The physical methods which adapt themselves to micro-analysis are (1) the spectroscopic examination of the emission spectra; (2) thermal conductivity; (3) dielectric constant. Without exception, however, all the physical methods have to be calibrated by the use of suitable gas mixtures before they can be used for the analysis of gas samples, and it is advisable from time to time to check the calibration by reference to a few standard gas mixtures. H. H. Ho.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

4212. Solution of Some Partial Differential Equations in the Finite Domain. W. T. Howell. *Phil. Mag.* 28. *pp*. 396–402, *Oct*., 1939.

4213. Formulæ for Product of Two Whittaker Functions with Different Arguments. W. T. Howell. *Phil. Mag.* 28. *pp*. 493–495, *Oct*., 1939.

4214. Formulæ for Generalised Hypergeometric Functions as Particular Cases of more General Formulæ. T. M. MacRobert. *Phil. Mag.* 28. *pp*. 488–492, *Oct*., 1939.

4215. Integration of a Certain System of Linear Partial Differential Equations of Hypergeometric Type. A. Erdélyi. *Roy. Soc. Edinburgh, Proc.* 59. 2. *pp*. 224–241, 1938–1939.

4216. Discussion of Bertrand's Problem. G. F. Evans. *Am. Phys. Teacher*, 7. *pp*. 174–176, *June*, 1939.—The problem is: If a chord be drawn in a circle, what is the probability that the length of the chord will be greater than that of a given chord? In the study the given chord is taken as the side of an equilateral triangle inscribed in the circle. Three solutions, giving different answers, are discussed and followed up by a consideration of what is meant by a random chord or line. It is concluded that the definition given by Morgan Crofton fits the experimental facts and also the theoretical solution giving the probability as 1/2.

S. A. S.

4217 Apparent Inconsistency Arising from Tests of Significance Based on Fiducial Distributions of Unknown Parameters. F. Yates. *Cambridge Phil. Soc., Proc.* 35. *pp*. 579–591, *Oct*., 1939.—

It has been observed that the Behrens and Fisher test of the difference of the means of two samples gives a smaller percentage of significant results than might be expected on the analogy of the ordinary *t* test with a pooled estimate of variance. The cause of this apparent anomaly is explained, and it is shown that the criticisms of the test to which the anomaly has given rise have their origin in (*a*) neglect of the relevant information provided by the estimated values of the variances, and (*b*) an insufficient appreciation of the fiducial basis of all tests of significance (including the ordinary *t* test) on small samples. It is pointed out that Sukhatme's table (constructed for the Behrens and Fisher test) also provides a test for the weighted mean of the means of two sets of observations, concerning whose relative accuracy no prior knowledge is available. AUTHOR.

***4218. Mechanical Integrator for the Product of Two Functions and Computation of I.C.I. Colour Specifications. J. A. Van den Akker.** *J.O.S.A.* 29. *pp.* 364–369, *Sept.*, 1939.

See also Abstract 4211.

MECHANICS, CLASSICAL.

***4219. Photographic Method for Study of Accelerated Motion. I. Walerstein.** *Am. Phys. Teacher,* 7. *pp.* 190–192, *June,* 1939.—The method described is designed for use in demonstration and lecture experiments, and simply consists in attaching a luminous point of light to the moving object and photographing this at short time intervals, so as to obtain a series of images on the photographic plate. For the purpose of interpolating the results, a graduated scale is included in the photograph, and the exposures are regulated by a disc, in which one or more narrow slots have been cut, which rotates at a known speed between the lens and the object. The method is used for determinations of gravitational acceleration and for experiments connected with the Atwood's machine and with the motions of projectiles and pendulums. R. W. P.

***4220. Production of Very Fine Quartz Fibres. A. H. S. Holbourn.** *Journ. Sci. Instruments,* 16. *pp.* 331–334, *Oct.,* 1939.—An elastic-catapult method of producing long lengths of quartz fibre between 0·1 and 5 μ in diameter is described. The chief advantages of the method are that it is reliable, and that the fibre is produced with both its ends attached to given points and is stretched tightly between them. [See Abstract 2888 (1924).] AUTHOR.

See also Abstract

2318B. Dynamics of Instruments. T. A. Rich.

MECHANICS, QUANTUM.

4221. New Form of the Quantum Equation. M. Fahmy. *Phil. Mag.* 28. *pp.* 364–369, *Sept.*, 1939.—The wave equation of a particle in a gravitational field is written in a new form. R.P.

4222. Variational Atomic Wave Functions. L. Goldberg and A. M. Clogston. *Phys. Rev.* 56. *pp.* 696–699, *Oct.* 1, 1939.—The energy tables constructed by Morse, Young, and Haurwitz [see Abstract 687 (1936)] to facilitate the variational computation of wave functions for atoms containing $1s$, $2s$, and $2p$ electrons have been extended to include $3p$ and $3d$ electrons. The best parameters, total energies, and term values are given for the states $(1s3d)\ {}^1D,\ {}^3D$; $(2p^2)\ {}^3P,\ {}^1D,\ {}^1S$; and $(1s^23d)\ {}^2D$ of the atoms He, Li, Be, B, C, N, O, F and Ne, and for $(1s3p)\ {}^1P$,

^3P of He I. It is shown that the observed energies of the 1snd states of He I are very accurately reproduced with the use of hydrogenic radial wave functions for both the 1s and nd electrons. AUTHORS.

4223. Sommerfeld's-Fine Structure Constant and Born's Reciprocity. A. Landé. *Frank. Inst., J.* 228. *pp.* 495–502, *Oct.,* 1939.—The problem of the electronic charge distribution together with that of the magnitude of Sommerfeld's fine-structure constant $\alpha = 2\pi e^2/hc = 1/137$ is reduced to a linear homogeneous integral equation for the density amplitude ψ. The kernel depends on the parameter α, and every value of α determines an eigenfunction. One eigenvalue α and one eigenfunction is selected by an additional condition which is the energy balance. The results are based on a hyperbolic sine relation between the momentum measurements of an inside and an outside observer, and on a similar relation between the space measurements of the two observers. Whereas the relations in momentum space are derived from the familiar Einstein energy-momentum equation, the space geometry of the particle is obtained by an application of the principle of reciprocity of M. Born. [See Abstract 1852 (1938).] AUTHOR.

See also Abstracts 4332, 4364, 4394, 4408 and

2308B. Photoelectric Effect and Action of Normal Waves. Probability and Entropy. J. Loiseau.

PRESSURE.

***4224. Vacuum Technique : Speed of Pumping and Molecular Flow. L. G. Parratt.** *Am. Phys. Teacher,* 7. *pp.* 207–219, *Aug.,* 1939. —A comprehensive survey of the important data connected with the design and especially the use of modern high-speed vacuum pumps. Formulæ involved in speed of pumps and of connecting tubing are given and explained, and methods of measuring speeds dealt with. The bearing of these results on the design of high-speed pumps is treated less fully. G. E. B.

See also Abstract 4420 and

2345B. Instantaneous Fluid Pressure Recording Equipment. S. E. Goodall and R. B. Smith.

RELATIVITY AND ETHER.

4225. Relativistic Theory of Electromagnetism. M. Manarini. *N. Cimento,* 16. *pp.* 191–201, *April,* 1939.—Using his plurivectorial calculus for space of four dimensions, the author obtains a new and simple form of Maxwell's equations for moving bodies, introducing a single "electromagnetic bivector" of zero divergence. The imaginary unit is not involved. The convection current density in real form is employed following Burgatti in establishing the equation of continuity for electric charge in motion. W. S. S.

4226. Simple System of Charged Particles in Milne's Kinematical Theory. D. N. Moghe. *Indian Acad. Sci., Proc.* 10*A*. *pp.* 31–36, *July,* 1939.—It is postulated that an accelerated particle of Milne's kinematical system is an electrically charged particle of charge e. It is further assumed that, if the electric force is X and the velocity and mass of the particle respectively u and m, the particle obeys the equation of motion $d(mu)/dt = eX$. Combining this equation with those found by Milne for the force on the particle, an electromagnetic theory for systems of such particles is formulated. G. C. McV.

4227. Stability of Motion in Milne's Kinematical System. D. N. Moghe. *Indian Acad. Sci., Proc.* 10*A. pp.* 41–44, *July*, 1939.—Milne has given the acceleration-formula for a particle in his kinematic system receding from the central mass-condensation [see Abstract 2384 (1937)]. This equation is studied from the point of view of small motions and it is found that the motion of the particle is unstable in general. But the stability or instability of the motion is independent of the position of the particular particle considered and it is also independent of the epoch. G. C. McV.

4228. Mass and Energy in a Gravitational Field. H. Greinacher. *Helv. Phys. Acta*, 12. 5. *pp.* 394–396, 1939. *In German.*—The formula for the alteration of mass with velocity deduced from special relativity is combined with the assumption that rest-mass is variable in a uniform gravitational field. The expression for the energy of a particle moving in this field and for the velocity after the particle has " fallen " a given distance are worked out. G. C. McV.

See also Abstracts 4223, 4389.

SOLUTION.

4229. Effects of " Massiveness " of Salts in Relation to Ionic and Atomic Characteristics. F. Vlès and M. Gex. *Comptes Rendus*, 209. *pp.* 377–379, *Aug.* 16, 1939.—The effect of a series of chlorides of various kations on the colour (measured spectrophotometrically) of cyanine sulphone 5R is investigated in order to establish the significance of the " massivity index " pM in the formula $pX = pM + (1/a) \log A/B$ (pX = negative log of molar concentration of salt, A and B are the quantities of the two extreme forms of the indicator, and a is an association factor). Linear relationships are now discovered between pM and the log of the effective number of charges on the atomic nucleus of the kation as defined by Born and Heisenberg [see Abstract 2178 (1924)]. The significance of these in other fields is discussed. C. B. A.

4230. Separation of Liquid Mixtures into Two Layers and Critical Opalescence. P. M. Monval and J. Quiquerez. *Kolloid Zeits.* 88. *pp.* 140–144, *Aug.*, 1939.—Previous work on opalescence is described together with a comprehensive study of the variation with concentration and temperature of numerous ternary heterogeneous systems with respect to density, refractive index, surface tension and viscosity. Based on the data obtained, an explanation of critical opalescence and of the constitution of opalescent solutions is submitted. H. H. Ho.

4231. Solubility of Gases. Part I. Inert Gases in Water. D. D. Eley. *Faraday Soc., Trans.* 35. *pp.* 1281–1293, *Nov.*, 1939.—The energy and entropy of solution of an inert gas molecule in water can be accounted for by two consecutive processes: (*a*) the formation of a cavity; (*b*) the gas molecule enters the cavity. The anomalous factors in the solubility of the inert gases in water, *e.g.*, the negative temperature coefficient and its rapid increase to zero as the temperature is raised to 80° C., is to be explained mainly by the energy and entropy associated with process (*a*), which have been calculated thermodynamically. The energy and entropy of cavity formation are zero at 4° C., but increase strongly with increase of temperature. A calculation of the energy of solution has been made from a simple model. An approximate partition function has been constructed which takes into account the influence of the water structure on the solution, and from it the entropy of solution has been calculated, and the main factors for the inert gases have been shown to be the loss of translational movement, and the entropy associated with cavity formation. The positive temperature coefficient observed for some gases in water above 100° C. is to be explained by the large energy required to form a cavity at these temperatures, which outweighs the solute-solvent attraction. AUTHOR.

4232. Rate of Dissolution of Iron in Acids. M. B. Abramson and C. V. King. *Am. Chem. Soc., J.* 61. *pp.* 2290–2295, *Sept.*, 1939.—The rate of dissolution of very pure Fe has been measured in solutions of several acids, with KNO_3, H_2O_2, KNO_2 and *p*-nitrophenol as depolarisers. Of these only the nitrate was found to be reasonably satisfactory. The rate was studied as a function of the depolariser concentration, the acid concentration, the concentration of various added salts, the stirring speed and the temperature. The rate was also measured in $FeCl_3$ solutions of various concentrations, at various stirring speeds and temperatures, with and without added acid. The rate is shown to be diffusion-controlled under all conditions in $FeCl_3$; at low stirring speeds in HCl with sufficient nitrate present, and approximately so in nitric acid with certain chloride concentrations. Under other conditions (higher stirring speeds, higher salt concentrations, low nitrate concentrations) it is in whole or part controlled by a slower reaction perhaps of chemical nature at the metal surface. Under conditions where the rate is diffusion-controlled, the temperature coefficient is about 1·35 per 10°; where it is "chemically" controlled, the temperature coefficient is 2·0–2·4 per 10°. The activation energies vary accordingly. AUTHORS.

See also Abstracts 4194, 4360.

SURFACE PROPERTIES.

4233. Calculations of Adsorption Behaviour of Argon on Alkali Halide Crystals. W. J. C. Orr. *Faraday Soc., Trans.* 35. *pp.* 1247–1265, *Oct.*, 1939.—Theoretical calculations are made for the adsorption systems A on KCl and on CsI of (1) the heats of adsorption and the equilibrium distances of the adsorbed atom at various positions on the surface, and (2) the variation of the heat of adsorption as a first layer of atoms built up and as a second layer begins. AUTHOR.

4234. Adsorption of He on Active Charcoal between 4·22° K. amd 1·78° K. A. van Itterbeek, W. van Dingenen and J. Borghs. *Physica*, 6. *pp.* 951–960, *Oct.*, 1939. *In English.*—Measurements were made on the adsorption of He on charcoal between 4,22° K., and 1,78° K. It was found that the adsorption isotherms can be closely represented by the analytic formula given by Williams' theory. The heats of adsorption were computed from these measurements by means of the Clapeyron-Clausius formula. It was found that the heat of adsorption passes at the λ-point through a minimum value of about 22 cal./mol., which corresponds closely to the condensation heat of liquid He. Measurements were also made on the adsorption velocity as a function of temperature in passing the λ-point. The observed phenomenon makes it probable that something occurs, which has some analogy with critical adsorption. AUTHORS.

4235. Electrolyte Adsorption and Activity Coefficient. Part III. Wo. Ostwald. *Kolloid Zeits.* 88. *pp.* 144–161, *Aug.*, 1939.—The experimental data of Odén, Anderson, Langelius, Rona, Michaelis, van Bemmelen, Ishizaka, Schilow and Lepin, on the adsorption of neutral salts by carbons of various kinds and electrolyte content, by MnO_2-gel, and by active alumina, have been employed to ascertain whether the linear relationship previously found [see Abstract **3156** (1939)] for the adsorption of strong acids by carbons is still valid, *viz.*, $f_x = af_{c-x} = b$, where f_x is the activity coefficient of the virtual concentration of the adsorbed solution, f_{c-x} is that of the equilibrium solution, while a and b are constants. In most cases excellent agreement with the linear relationship was found. In the cases of salts with multivalent ions in the molecule, the concentrations employed were too high for the physical activity theory to be applied. As in the cases of acid adsorption, only strong electrolytes were found to conform with the linear relationship, *e.g.*, CdI_2 gives a systematic curve of similar shape to that afforded by acetic acid. A quantitative character for the adsorption activity of strong electrolytes is now established by the present work. H. H. Ho.

4236. Capillary Properties of α-Amino-Acids. J. W. Belton. *Faraday Soc., Trans.* 35. *pp.* 1293–1298, *Nov.*, 1939.—Measurements have been made of the surface tensions of (*a*) aqueous solutions of glycine, alanine, α-amino-butyric acid and valine, and (*b*) solutions of these acids with the addition of sodium chloride in varying amounts. The slope of the surface tension-concentration curve varies with the length of the hydrocarbon chain and this variation becomes more marked in the presence of salt. The effect of sodium chloride on the surface layer is discussed, and it is shown that in the case of alanine salt changes the sign of the acid adsorption from negative to positive. AUTHOR.

4237. Effect of Salts on Surface Tensions of Gelatin Solutions. J. W. Belton. *Faraday Soc., Trans.* 35. *pp.* 1312–1316, *Nov.*, 1939.—The surface tensions of dilute aqueous solutions of gelatin to which NaCl, KCl, LiCl, KI or $BaCl_2$ has been added in varying concentrations, have been measured by the bubble pressure method. The surface tension-salt concentration curve shows a maximum for NaCl, is almost horizontal for KCl, and increases almost linearly but with a lower slope than for the isomolal salt solution, for both LiCl and KI. These curves are interpreted in terms of the surface structure of the solutions. AUTHOR.

4238. Structure of Protein Films. E. G. Cockbain and J. H. Schulman. *Faraday Soc., Trans.* 35. *pp.* 1266–1276, *Oct.*, 1939.—The structure of protein films has been considered in the light of information revealed by a study of the force-area and surface potential-area characteristics of gliadin films and by the interaction of the films with tannic acid. Stereochemical considerations are advanced in support of the view that separation of the polar from the non-polar side chains of a protein at an air/water interface takes place by means of a looping of the polypeptide chains. The mode of looping depends on the proportion of polar to non-polar side chains and on the sequence of these side chains along the main polypeptide chain. Reasons are given to show that protein films cannot consist of fully extended polypeptide chains of the β-keratin type or of any other regular polypeptide pattern as has usually been assumed. At large areas gliadin films consist of two-dimensional micelles, as shown by the interaction with tannic acid. This is in marked contrast to the reaction between tannic acid and amine films. On compression of gliadin films, water is first squeezed out of the intermicellar and intramicellar spaces, the apparent electric moment $\bar{\mu}$ remaining constant. Further compression, from about 2 dynes/cm. to the collapse point, results in a re-orientation of the protein units, the polypeptide chains being progressively turned from the plane of the water surface to an inclined plane. In this region the compressibility of the film is approximately constant. The gelation process is probably aided by a favourable adlineation of the looped polypeptide chains in the micelles. The forces causing gelation probably consist chiefly of simple dipole interactions, van der Waals' forces of adhesion, and, in some cases, salt linkages. The interaction between gliadin films and tannic acid was shown to be strongly dependent on the pH, the nature and concentration of the anions in the underlying solution, and on the surface pressure of the film. AUTHORS.

4239. Correspondence between Changes of State in Two and Three Dimensions. D. Dervichian. *J. de Physique et le Radium*, 10. *pp.* 333–349, *July*, 1939.—This is a connected account of recent researches on the nature and structure of monomolecular films, comparing the two-dimensional solid, various forms of expanded, liquid and gaseous films with the three-dimensional solid, mesomorphic, liquid and gaseous states of matter. The relations between the various forms are illustrated by many pressure-area isotherms of the higher fatty acids and their triglycerides, in particular of trimyristine. The series of isotherms for different temperatures for the same substance are shown to be quite similar to those at one temperature for a series of substances containing varying lengths of carbon chain. The critical temperatures of liquefaction, crystallisation, etc., of the films are shown to correspond with transition points of the corresponding three-dimensional materials, though a stable state of the one may correspond with an unstable state of the other. C. A. S.

4240. Theory of Formation of Protective Oxide Films on Metals. N. F. Mott. *Faraday Soc., Trans.* 35. *pp.* 1175–1177, *Sept.*, 1939.—Many metals, *e.g.*, Zn, when exposed to air develop an oxide film on the surface whose thickness x increases with time t according to the parabolic law $x^2 = \text{const.}\ t$. For others, notably Al, the film develops according to the parabolic law only up to thicknesses of the order of 10^{-6} cm., and then ceases. The explanation suggested for the parabolic law is that at the metal-oxide interface metal atoms go into solution in the oxide, there dissociating into interstitial ions and free electrons in the conduction band of the oxide. If n/x be the concentration gradient of the atoms in the oxide film, D the diffusion coefficient of the ions and Ω the volume of the oxide per metal ion, then $dx/dt = 2\Omega n/x$, giving $\frac{1}{2}x^2 = 2\Omega Dnt$. In other cases (*e.g.*, the oxidation of Cu) O_2 is dissolved at the oxide-gas interface, but the theory above relates only to cases of the former type. If the oxide be assumed to be an insulator, *i.e.*, contain no interstitial ions or electrons, the concentration n of (dissociated) atoms in the layer next to the metal will be given by $n^2 = A^2 \exp.\{-(\pi_1 + \pi_2)/kT\}$, where $1/A$ is of the order of the volume of the unit cell of the oxide, π_1 is the energy required to bring an electron from the metal into the conduction band of the oxide, and π_2 the energy to bring an ion from the metal into an interstitial position in the oxide. If $\pi_1 + \pi_2$ is too large, n will be negligibly small and the oxide film cannot grow. If $\pi_2 < \pi_1$, ions can pass until prevented by the space charge set up, when growth ceases abruptly.
H. H. Ho.

See also Abstracts 4320, 4360, 4388 and

2330B. Light Transmission and Electric Conduction in Metallic Films. Y. Saito.

VISCOSITY AND FRICTION.

4241. Viscosity of Dilute Solutions of Long-Chain Molecules. Part III. M. L. Huggins. *Kodak Research Lab., Comm. No.* 713. *J. of Applied Physics,* 10. *pp.* 700–704, *Oct.,* 1939.—An equation has recently been derived for the specific viscosity of a dilute solution of "randomly-kinked" chain molecules, which, for long chains and small concentrations, is of the same form as Staudinger's empirical "law": $\eta_{sp} = k_s nc$. The validity of this equation for actual solutions, and the nature and magnitude of the deviations to be expected are discussed. Among the effects considered are those due to restriction of rotation about the bonds in the chain and to the size and nature of the solvent molecules, of the repeating units in the chain, and of the end groups. [For Part II see Abstract 1962 (1939).] AUTHOR.

***4242. Gas Viscosities by Capillary Flow. R. L. Weber.** *Am. Phys. Teacher,* 7. *pp.* 163–164, *June,* 1939.—Apparatus is described, suitable for use by students, employing a thermo-regulator, whereby the viscosity of air can be determined sufficiently accurately (within 2%), to check Sutherland's formula. J. S. G. T.

4243. Properties of Flow of Liquid He II. J. F. Allen and A. D. Misener. *Roy. Soc., Proc.* 172*A. pp.* 467–491, *Sept.* 4, 1939.—The hydrodynamic properties of liquid He II have been investigated by flow measurements through capillary tubes varying in dia. from 1 mm. to 1×10^{-5} cm., and through fine tightly packed powder. The results with the powder could be interpreted according to classical hydrodynamics over the whole experimental range in He II from the λ-point to 1·15° K., but the flow through capillaries bore no relationship to ordinary laminar or turbulent flow, although the latter conditions were approached for large capillaries close to the λ-point. The picture is not yet complete, but it appears that the results can be interpreted by the occurrence of two types of flow, one a surface flow along the walls of the capillary with a velocity independent of pressure, and the other, which is predominant in large capillaries, corresponds to a viscosity of the order of 10^{-4} c.g.s. units. The value increases with decrease in temperature and just below the λ-point is probably not very different from that of He I. R. W. P.

See also Abstracts 4206, 4354.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***4244. Double-Image Micrometer for Double-Star Measurements. P. Muller.** *Rev. d'Optique,* 18. *pp.* 172–196, *May,* 1939.—The author describes his comparison-image micrometer employing a birefringent prism [see Abstract 1003 (1938)] in sufficient detail for other double star observers to construct and use successfully a similar instrument. In a comparison with the filar micrometer, based on 2 years' observing since the micrometer was first constructed, he points out that the constants of the older instrument are known more accurately than is needed, but that the actual errors of measurement are large, variable, and follow complex laws. With the new device, the determination of the instrumental constants is difficult; but once done, the actual measures, in both position angle and separation, can be obtained to less than 1%, which is far superior to the old method for close binaries. From 465 measures of distance and 399 of position angle on 76 stars whose separation is from 1″·2 to 16″, the mean error of a final value is found to be 0·80% in distance and 0·76% in angle. A. Hu.

COSMOGONY.

See Abstracts 4226, 4227, 4249.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

4245. Gravitational Motion of a Pair of Rigid Bodies. T. E. Sterne. *Nat. Acad. Sci., Proc.* 25. *pp.* 468–473, *Sept.*, 1939.—Walter has studied the nature of the nearly elliptical motion of a pair of rigid bodies, whose small librations in the orbital plane are taken into account. Walter's solution of this problem, although inapplicable probably to real binary stars, is nevertheless of dynamical interest. His solution, which has been adversely criticised on dynamical grounds, is here completely confirmed. Under appropriate circumstances instability, apsidal precession or apsidal regression may each occur. [See Abstract 1048 (1939).] Author.

NEBULÆ.

See Abstract 4250.

PLANETS.

4246. Phenomena Accompanying the Southern Polar Cap Regression on Mars. R. J. Desloges. *Comptes Rendus*, 209. *pp.* 344–346, *Aug.* 7, 1939.—At the author's observatory at Sétif, Fournier and Hudelot observed at the opposition of Mars in 1924 the epoch and positions of the principal fissures, which seemed to issue from a central sinus; they extended along 80° parallel, between 150° to 330° meridians, but were not all necessarily coexistent. They find that the climatic conditions in southern Mars are very stable. Novissima Thyle broke off at the same epoch as an island, in 1909 and 1924 (within 2 days). Yellow colours are characteristic of the early southern spring, the yellowness being due to vapours, and indicate a very transparent atmosphere, at this time of year. The polar cap "dark" border is real, and not due to contrast. Several of the troughs correspond exactly to the positions of fissures (already disappeared), and are comparable in size with these. A. S. D. M.

STARS.

4247. New Emission Lines in Spectrum of γ Cassiopeiæ. Tcheng Mao-Lin and J. Dufay. *Comptes Rendus*, 209. *pp.* 342–344, *Aug.* 7, 1939.—A study by means of 3 different objective prisms of the γ Cassiopeiæ spectrum between $\lambda\lambda$ 3750–5876 in the interval, Oct. 1937 to July 1938. The authors have identified a number of lines of doubly ionised iron; a table is given. [See Abstract 171 (1939)]. Struve and Swings [see Abstract 3657 (1932)] found that the γ Cass. emission lines had an ionisation potential of 18·2 V, but for Fe III lines, at the given interval, Edlén and Swings give it as 30·48 ± 0·03 V. The excitation is therefore considerably greater in 1937–1938. A table of Fe III is given.

Research in Fe II is rendered difficult by numerous superpositions.
A. S. D. M.

4248. Gaseous Matter in Neighbourhood of Stars. B. Jung. *Zeits. f. Astrophysik*, 18. 4–5. *pp*. 252–271, 1939.—On the basis of Milne's theory of stellar chromospheres, the author examines the chromospheres of ideal stars whose masses, superficial temperatures, and atmospheric excitation potentials show the greatest possible variety. The gas density in the lower chromospheres of giants is independent of the mass of the star; massive stars, and in particular red giants, can possess atmospheres of extremely great depth. If the star is considered a source of pure temperature radiation, only those elements may appear in the chromosphere whose ionisation potentials are considerably above the excitation potential. The existence of H and He lines in the solar spectrum, however, provides an exception to this rule. It is therefore believed that stars cannot be considered as black-body radiators in the extreme u.v.; line emission must here play a decisive part. A. Hu.

4249. Evolution of Stars. F. Hoyle and R. A. Lyttleton. *Cambridge Phil. Soc., Proc.* 35. *pp*. 592–609, *Oct*., 1939.—Difficulties associated with the evolution of stars by radiation alone are briefly discussed. It is clear that some other process is also affecting the stars, and it is shown that the stars are capable of adding to their mass by the process of accretion of the cosmical cloud. The gravitation of a moving star causes additional collisions of the atoms of the interstellar matter, and the motions become randomised to such an extent that the star probably captures all material passing within the distance at which the velocity of the star relative to the cloud is the parabolic velocity. This rate of accretion of mass of a star is $4\pi\gamma^2\rho M^2/v^3$, and is accordingly of great importance for stars of low velocity. Stars of high velocity are least affected by accretion and therefore in general remain of low mass, while stars of low velocity must attain great mass. The periods of time involved in bringing about appreciable changes in the mass of a star are of the order of 5×10^{10} years and are in agreement with independent estimates of the time scale, as deduced, for example, from the companion of Sirius. The evolution of the components and orbits of binary stars are consequences of the accretion process. The more massive component increases in mass more rapidly than the less massive component and may therefore in general continue to emit more ergs per gramme. The orbit evolves in such a way that the total angular momentum remains constant. For equal masses the separation is proportional to the inverse cube of the mass, and the period to the inverse fifth power, so that great changes of separation and period occur. The evolution of the stars is governed almost entirely by their velocities relative to the cosmical cloud. In the case of double stars the evolution takes the form of decreasing period and decreasing separation. Such features as galactic concentration and the correlation between spectral type and velocity are direct results of accretion. AUTHORS.

4250. Galactic and Extra-Galactic Studies. Part I. Stellar Corona around the Galactic System. H. Shapley. *Nat. Acad. Sci., Proc.* 25. *pp*. 423–428, *Aug*., 1939.—The author finds a low density "atmosphere" or "stellar corona" whose plane is 80000 light years thick. The most distanct objects are not, as a rule, intergalactic, though a few may be free of our gravitational system. 584 cluster variables are of median magnitude, fainter than 15, and these are among the most distant known objects in the galaxy. A table gives a list of 14 fields in the S. galactic hemisphere;

on the average there is about 1 cluster variable to every 6 square degrees. A second table gives the frequency of cluster variables in the same region, and a figure gives the concentration of cluster-type Cepheids to the galactic plane. He enumerates the 10 southern cluster variables that are at the greatest distance from it. A. S. D. M.

4251. Problem of Mira. W. A. Luby. *Roy. Astron. Soc. Canada, J.* 33. *pp.* 255–259, *July–Aug.*, 1939.—The long-period variable star Mira shows a variable light period, a variable light change, two types of spectra at maximum, a maximum velocity of recession at maximum light, and of approach at minimum light. This paper offers an explanation of these phenomena based on the tidal action on Mira of a small invisible companion. The low density of Mira would allow of enormous tidal deformation resulting in an egg-shaped primary. Maximum brightness would correspond to " broadside on " positions, minimum brightness to " end on " positions. The theory postulates two light maxima in each orbital period, which would thus be 663·2 days, or twice the accepted light period. Quantitative details are discussed. Theory would be satisfied by a mass ratio of 81 between primary and secondary, the actual mass of the secondary being about 73 times that of Jupiter. It is suggested that the difference between the long and short diameters of the primary might be detected by the interferometer at Mount Wilson. E. M. W.

4252. Distant Variable of RR Lyræ Type in Region of Galactic North Pole. H. O. Grönstrand. *Arkiv f. Mat. Astron. och Fysik, Stockholm*, 26*A*. 17. [25 *pp.*], 1939. *In German.*—A photographic investigation is made of a variable star of magnitude 14 discovered by Malmquist near the galactic north pole ; this star is classified by Prager as No. 3529, its coordinates for 1900·0 are $\alpha = 12^h\ 8^m\ 44^s$, $\delta = +\ 31°32·6'$. The brightness measurements are made with reference to 13 comparison stars within 16′ of No. 3529, the comparison stars covering the complete range of brightness of the variable. As a preliminary to the main investigation the brightnesses of the comparison stars are accurately determined. From the form of the light curve of No. 3529 it is concluded that it is a short period Cepheid variable, i.e. a variable of the RR Lyrae type. The period of the variable is about $0^d·461$ but individual measurements vary between $0^d·548$ and $0^d·463$; the minimum precedes the maximum by about $0^d·14$. The amplitude of brightness is $1^m·7$ with maximum and minimum brightness of $12^m·9$ and $14^m·6$. The distance of the star is 5600 parsecs and its spectral type is A2 or A3. J. E. K.

See also Abstracts 4244, 4245, 4265.

SUN.

4253. Motion of Eruptive Prominences. M. Waldmeier. *Zeits. f. Astrophysik*, 18. 4–5. *pp.* 241–251, 1939.—The author extends his previous work [see Abstracts 2777 and 4410 (1938)] on the motion of prominences which escape the sun and are lost in outer space, and gives details of 4 new eruptive prominences. The second law of motion, as originally stated, is shown to be incorrect, though the observations appear compatible with a modified restatement of the law. It is pointed out that for the clarification of the laws as at present known, experimental evidence is necessary which should be of increased accuracy and should include more height measurements during the eruption. Kinematograph exposures on the coronograph satisfy these conditions. The evidence indicates that each individual outburst may have its essential features uniquely described by a single parameter whose value is totally different according as the prominence does or does not arise from a spot-free area of the disc. A. Hu.

4254. Zeeman Effect in Sunspots. T. Tanaka and Y. Takagi. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 421–431, *July, and p.* 496, *Aug.*, 1939. *In English.*—Results are given of an investigation into the Zeeman effect in the case of a remarkably large sunspot which appeared in November, 1938. The lines examined lie between 4700 and 6450 Å and number about 60, a dispersion of 0·4 Å/mm. being employed. The main results are (1) the effective magnetic field for each of the components of a multiplet is the same, (2) the effective magnetic fields for the different elements are quite different from one another and appear to be regularly arranged in the order of their atomic numbers. A. H.

4255. Band Spectra in Sunspots. T. Tanaka, S. Nagasawa and K. Saito. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 431–455, *July*, 1939. *In English.*—Using high dispersion a detailed examination for band spectra lines is made in the spectrum of the large sunspot of November, 1938. Instead of examining the sunspot spectrum for every line in known band spectra, a preliminary investigation decides which lines—in the case of a certain band spectrum—it is reasonable to expect to be present. On the basis of this it is concluded that MgH, TiO and CaH certainly were present in this sunspot, that CN was doubtful, whilst no evidence for the existence of BO, AlH and AlO was obtained, the coincidences in the last four cases being within the range of chance coincidence. A. H.

See also Abstract 4335.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

***4256. Mobile Seismic Recording Unit. F. M. G. Murphy, S. T. Cope and J. H. Jones.** *Phil. Mag.* 28. *pp.* 370–380, *Sept.*, 1939.—The unit is intended mainly for use with the reflection method. Six seismic detectors are connected to a central recording van, in which the signals from the detectors are filtered, amplified and recorded by means of a string oscillograph. The oscillograph also records the time of the explosion, and is for this purpose connected to the explosion-point by a landline or by wireless transmitter. This connection also serves the purpose of activating a relay which keeps the amplifiers insensitive until the moment of the explosion, and gradually builds up the sensitivity after that, so that the initial heavy disturbances cannot damage the instruments. R. P.

METEOROLOGY.

4257. Atmospheric Ozone. E. Vassy. *J. de Physique et le Radium,* 10. *p.* 366, *July,* 1939.—This second short note still upholds the author's method, further reasons being elaborated. [See Abstract 3589 (1939).] E. E. W.

4258. U.V. Solar Radiation at 2150 Å. E. Meyer, F. Müller and K. Zuber. *Helv. Phys. Acta,* 12. 5. *pp.* 415–420, 1939. *In German.*—Doubts have arisen regarding measurements of intensity of radiation at 2150 Å owing to the effects of scattering. It was found to increase rapidly with height above the ground but there were very great irregularities. Kiepenhauer was unable to detect it with a double monochromator but did later with a monochromator. In a table the intensity of solar radiation at Jungfraujoch is given for specified wave-lengths covering the period of Kiepenhauer's measurements. The oscillations of intensity were outside those expected on statistical grounds and Kiepenhauer's conclusions on the presence of 2150 Å are considered invalid. The oscillations agree with those found by Barbier and Chalonge on ozone clouds in stellar observations. R. S. R.

4259. Intensity of Telluric Penetrating Radiation in Auvergne. J. Bricard and J. Jung. *Comptes Rendus*, 209. *pp*. 485–488, *Sept*. 18, 1939.—The results of measurements of radiation-intensity made over various types of rock at mineral springs and at a disused boring are given in tables. Over rocks the intensity is found to be of the same order whatever the geological substratum. From mineral springs it is about double the amount observed over rocks. The effects from both these sources are small, however, when compared with that observed at the top of an old boring. There the number of ions/sec./cm.^{3} is more than 10 times that from sedimentary rocks. The authors intend to investigate this remarkable ion production. A. E. M. G.

4260. Atmospheric Circulation above the Red Sea. R. Tournier. *Comptes Rendus*, 209. *pp*. 488–490, *Sept*. 18, 1939.—It has been considered that a circulation of the trade wind type must exist above the Red Sea. In order to examine this, observations were made with balloons during the periods July and Sept., 1938, and Feb. and April, 1939. The results of these observations are discussed. It is found that on the whole Africa exercises a greater influence on the wind system than Asia, but that the local winds appear to be influenced equally by the two continents. Soundings reaching heights of 3000 to 4000 m. indicate a layer of about 2000 m. in thickness moving with a velocity of about 4 m./sec. from west to east. The author considers that if the orographical system round the Red Sea was modified the general wind system would also be modified, and as a result Africa would receive more rain from the Red Sea than it does at present. A. E. M. G.

4261. Readjustment of Certain Unstable Atmospheric Systems under Conservation of Vorticity. V. P. Starr. *Monthly Weather Rev*. 67. *pp* 125–134, *May*, 1939.—If on a rotating earth, a layer of incompressible fluid of uniform depth and infinite horizontal extent composed of two motionless fluid masses of different density and separated initially by a plane vertical partition, is allowed to readjust itself slowly upon removal of the partition, the system will come to a state of equilibrium in which the two masses are separated by an inclined boundary sloping downward toward the lighter fluid mass, and in which the free surface is deformed in such a manner that the maximum depth occurs at a point above the internal boundary and the minimum depth at the point where the thickness of the lighter fluid becomes zero. All frictional effects and mixing at the boundary of the fluids are assumed to be absent and the Coriolis parameter is not assumed to vary within the dimensions of the system. Horizontal velocities parallel to the original discontinuity will be set up due to the action of pressure gradients and Coriolis forces during the readjustment of the system and the distribution of these velocities with latitude and depth is obtained. A decrease of potential energy of mass distribution occurs during the readjustment and in the final state

a certain amount of kinetic energy represented by the velocity distribution is described. A certain amount of kinetic energy of oscillation is set free. A similar problem involving the presence of a third mass of fluid overlying the system can be treated in a similar way except for numerical values.
R. S. R.

4262. Computation of Depth of Precipitable Water in a Column of Air. S. B. Solot. *Monthly Weather Rev.* 67. *pp.* 100–103, *April*, 1939.—An expression is derived to determine, Wp, the depth of precipitable water, from aerological observations and for practical purposes it can be expressed in the form $Wp = 0 \cdot 0004 \int_{P_{5km}}^{P_s} q \, dp$, where q is the specific humidity and P is the pressure in mb. The value of this integral can be approximated by plotting q and P and computing the area under the curve. An example is given for the curve and tabulated values of Wp.
R. S. R.

4263. Effect of Atmosphere on Apparent Intensities of Distant Luminous Sources. F. Link. *Rev. d'Optique*, 18. *pp.* 101–108, *March*, 1939.—A formula is developed giving the refraction of a light ray in the lower layers of the atmosphere where the temperature decreases linearly with the height. The formula is applied to derive the change in apparent candle-power of a very distant light source due to atmospheric refraction. The effect is found to be small and almost always negligible. An approximate formula is also developed for the total air mass along the path of a ray, which determines the atmospheric absorption. It is concluded that in considering apparent intensity of distant light sources the effect of atmospheric absorption alone need be allowed for. W. S. S.

4264. Transparency of Atmosphere. Part III. J. Duclaux. *J. de Physique et le Radium*, 10. *pp.* 367–374, *Aug.*, 1939.—In the present section previous observations on the transparency of the atmosphere are submitted to a close examination to determine whether they have been properly interpreted. Measurements made by Müller and Kron at Teneriffe have been considered as verifying Rayleigh's theory. The author finds that they lead to a different law, *viz.*, λ^{-3}, and do not support Rayleigh's theory. Neither is it possible to deduce the thickness of the O_3 layer as previously maintained. While it is admitted that a part of the absorption follows a law, λ^{-4}, it is necessary to diminish the numerical coefficient given by the theory. Returning to the formula, λ^{-3}, the author concludes that of all the functions tried, it represents best Müller and Kron's results. But he considers that formulæ alone will not solve the problem of atmospheric transparency. All these formulæ ignore the causes of selective absorption and it will be necessary to know the corresponding corrections before the law can be found. [For Part II see Abstract 4950 (1935).] A. E. M. G.

4265. Absorption of Light by the Atmosphere. A. Vassy and E. Vassy. *J. de Physique et le Radium*, 10. *pp.* 75–81, *Feb. and pp.* 403–412, *Sept.*, 1939.—A detailed account of work already noted [see Abstract 3621 (1938)]. W. R. A.

4266. 27·3-Day Period in Aurora Borealis. F. E. Dixon. *Terr. Mag.* 44. *pp.* 335–338, *Sept.*, 1939.—A study of the occurrences of aurora in Scotland during the years 1858–1938 reveals a well-marked period of about 27·3 days. The sources of information are indicated and the method of analysis given in detail. The data were evaluated for each solar cycle and the results found are shown diagrammatically. The curves obtained are similar with the exception of that for the intermediate cycle, but the earlier set differs in phase from the latter by about seven days. Reasons for this are considered. The variations of magnetic activity and of auroral frequency are also compared, the former showing a frequency twice that of the latter. In considering the cause of the 27·3-day period, the author concludes that it is due to some solar phenomenon occurring in a particular area of the sun's surface which moves only slightly in longitude. A. E. M. G.

4267. Na D-Lines in Light of Night Sky. G. Cario and U. Stille. *Zeits. f. Physik*, 113. 7–8. *pp.* 442–448, 1939.—Previous measurements and hypotheses of the yellow-orange glow of the night sky are discussed critically. Measurement of the widths of the emitted D lines should throw light on their excitation mechanism and the origin of the Na in the glowing layer. An apparatus of high light intensity for measurement of absorption line-widths in the night-sky spectrum is described. J. E. K.

See also Abstracts 4326, 4418.

SEISMOLOGY.

4268. Microseisms Caused by Transmission of Atmospheric Disturbances. Part I. K. Sezawa and K. Kanai. *Tokyo Univ. Earthquake Research Inst., Bull.* 17. *pp.* 190–207, *June*, 1939. *In English.*—From mathematical investigation it has been ascertained that the prevalent periods of vibration in microseisms result from the nature of the stratification in the path of transmission of the disturbances. The origin of the prevalent periods of the microseisms is known since the amplitude of waves is a maximum whose length is twice the thickness of the layer of transmission. A stratified condition of the atmosphere possibly exists when there is a turbulent thin layer on the ground or, at any rate, when there is a steady air current outside or within the lower part of the atmosphere. In the case of atmospheric waves two prevalent periods may exist, those of a gravitational nature having prevalent periods of a few minutes and those of a compressional nature with prevalent periods of only a few seconds. Even should the compressional and gravitational forces be coupled this condition is virtually the same as the resultant of the pure compressional and pure gravitational conditions. R. S. R.

***4269. Ground Vibrations near Dynamite Blasts. L. D. Leet.** *Seismological Soc. of America, Bull.* 29. *pp.* 487–496, *July*, 1939.—The recording arrangement is described whereby the horizontal (in 2 mutually perpendicular directions) and vertical displacements are recorded and exemplars of the records given. The various resultant waves have different velocities so that the effective amplitude at any one spot diminishes rapidly with its distance from the seat of the explosion. High frequencies and short duration are characteristic of records on rock, the reverse on unconsolidated earth. C. A. S.

***4270. Recording Tiltmeter. W. H. Eller.** *Seismological Soc. of America, Bull.* 29. *pp.* 481–484, *July*, 1939. —The instrument is of the horizontal pendulum type and resembles a seismograph in many ways, the fundamental difference being that the coupling between the pendulum boom and the magnifying lever is purely magnetic, thus preventing the dismantling liable to occur when a sensitive seismograph receives a fairly sharp shock. As designed it requires attention only once a week. It is described in some detail, and is responsive to a tilt of 0·01 sec. C. A. S.

See also Abstract 4256.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

4271. Terrestrial Magnetic Field Strength at High Altitudes Deduced from Ionosphere Studies. R. Jouaust, E. Théllier and H. Jardy. *Comptes Rendus*, 209. *pp.* 382–384, *Aug.* 16, 1939.—Using vertical sounding, reflection from the E-layer (just over 100 km.) commences at about 3·2 kc./sec., and continues to about 4·6 kc./sec. At about 4 kc./sec., however, reflection (of the ordinary ray) from the E-layer (200 km. and upwards) begins. From here on, the E-layer reflection is that of the extraordinary ray. This is confirmed by calculation of the frequencies from a formula given, connecting them with the value of the terrestrial magnetic field in the ionosphere. The field value found for the F-layer, 0·42 gauss, checks with the value calculated, assuming the terrestrial magnetism to be due solely to internal action; and with Appleton's finding of its being 10% below the ground value. R. M.

***4272. Induction Magnetograph for Recording Sudden Changes of Terrestrial Magnetic Field. H. Nagaoka and T. Ikebe.** *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers, No.* 915. *pp.* 183–197, *Aug.*, 1939. *In English.*—A magnetograph for measuring the time rate dH/dt of the terrestrial magnetic field H with a special shape for collecting the lines of force into a permalloy core enclosed in a cylindrical coil is described. A record of the complicated magnetic disturbance caused by electric trams is given. Comparison of the apparatus by simultaneous observations of dZ/dt with induction loop of $8\cdot25 \times 10^4$ m^2. at Kakioka Magnetic Observatory, showing the reliability of the apparatus, is given by graphs. The effect of earthquake shocks is discussed from the instrumental side. A sketch of the volcanological study with the apparatus, and various uses in ionospheric investigations are suggested. The difficulty of finding a proper site for installing the apparatus is explained. [See also Abstract 2509 (1937).] AUTHORS.

***4273. Influence of Surrounding Air on Time of Vibration of Magnet. J. Veldkamp.** *Terr. Mag.* 44. *pp.* 257–258, *Sept.*, 1939.—A correction of the period of a vibrating magnet due to motion of the air was given by A. Burger in a dissertation in 1935. The time of vibration decreases as the pressure diminishes, and the correction is changed when an inertia bar is added. The author corrects some inaccuracies in Burger's application of his results to practical cases. The influence of the air moving with the magnet can partly account for the systematic differences (*ca.* 10 γ) between the measurements of H by means of instruments used at different observatories. G. E. A.

4274. Prediction and Mutual Correlations of the Maps of Distribution of Magnetic Elements and their Annual Changes. B. P. Weinberg. *Terr. Mag.* 44. *pp.* 277–282, *Sept.*, 1939.—For an element E the mean secular $\bar{E}_0$ around which the value of the element oscillates during the period T years, an equation is given which permits using the value $E(t)$ at the epoch T to forecast the value of the annual change E' $(t + T/4)$ for the epoch a quarter of the period after or to indicate retrospectively the value of the annual change E' $(t-T/4)$ for the epoch a quarter of the period before. If in addition the period of variation of the element E is identical for all the surface of the Globe, as may be assumed with reasonable certainty for the magnetic declination and for which the period is of the order of 580 years, the confrontation of the distribution chart of $\dot{E}$ and that of E for the epoch t makes it possible to construct charts of the isopors $\dot{E}'$ for the epochs $(t + T/4)$ and $(t - T/4)$. Charts are supplied to illustrate the process. R. S. R.

See also **Abstract 4419.**

RADIOACTIVITY.

***4275. Calorimetric Study of Radiation from Th Active Deposit. L. Winand.** *J. de Physique et le Radium*, 10. *pp.* 361–365, *July*, 1939.—A new precision adiabatic calorimeter has been constructed, and calibrated by measuring the energy liberated by a Po source. Using simultaneously the methods of uniform and of non-uniform temperature, the energy liberated by Th active deposit has been determined; it is concluded that 1 mgm. γ equivalent = 1·09 mC. E. E. W.

4276. Disintegration of ^{24}Na. S. Kikuchi, Y. Watase, J. Itoh, E. Takeda and S. Yamaguchi. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 381–388, *July*, 1939. *In English.*—The β- and γ-rays from ^{24}Na have been examined by means of the magnetic spectrometer. The inspection upper limit of the β-spectrum was found to be 1·37 ± 0·03 eMV being lower than that obtained by several investigators, but in agreement with the recent determination of Feather and Dunworth. The Fermi plot can be represented by three straight lines, indicating three groups of electrons with maximum energies of 1·37, 1·15 and 0·6 eMV respectively, thus suggesting two excited states of ^{24}Mg with energies 0·77 and 0·22 eMV with possible γ-rays of energies of about 0·8, 0·55 and 0·2 eMV. In investigating the γ-rays emitted the energies of the secondary electrons from C and Pb were measured by the magnetic spectrometer. γ-rays of energies 2·97 ± 0·05 and 1·55 ± 0·05 eMV were detected of about the same intensity, and a possible third of energy 0·8 eMV. Evidence for γ-rays of still lower energy was not conclusive. The energy of the hardest γ-rays is the only one in agreement with the determinations of Richardson. W. E. D.

4277. Growth of Chain Reaction in Mass Containing U. F. Adler. *Comptes Rendus*, 209. *pp.* 301–303, *July* 31, 1939.—The work of Perrin [see Abstract 3232 (1939)] is generalised in such a way as to include the variation of neutron density with time. R. P.

4278. Detonation of Nitrogen Iodide by Fragments of U Bombarded by Neutrons. P. Fabre, C. Magnan and H. Muraour. *Comptes Rendus*, 209. *pp.* 436–438, *Sept.* 4, 1939.—Experiments are described showing that nitrogen iodide mixed with UO_2 detonates much more readily when bombarded with neutrons from Ra + Be, than when only subjected to the action of the α-particles from the U, thus supporting the view that detonation is mainly due to the broken fragments of the U nucleus produced by impact of neutrons from Ra + Be [see Abstract 2020 (1939)]. Similar exposure of mixtures of PbN_6, diazo-*m*-nitraniline, hexamethylenetetramine peroxide, trinitritriazidobenzene, Hg fulminate, or fulminating Au with UO_2 gave no result. The last named also did not explode on exposure to α-particles, or to the results of a possible rupture of the Au nucleus. C. A. S.

4279. β-Decay and Spin of Light Nuclei. B. O. Grönblom. *Phys. Rev.* 56. *pp.* 508–511, *Sept.* 15, 1939.—The β-decay of the nuclei He^6, Be^7, N^{13}, O^{15} and F^{17} is investigated from the point of view of the Gamow-Teller modification of the Fermi-theory. It is assumed that the lowest state of each nucleus forms a spin-multiplet. The various transition probabilities are given as functions of the total angular momentum I of the various states of the nuclei. An accurate knowledge of the β-spectrum would lead to a definite prediction of the spins of the nuclei. For the time-constant in the β-theory a value of 3×10^3 sec. is obtained as compared to the previous value of 11×10^3 sec. AUTHOR.

4280. Coupling Conditions in Light Nuclei and Lifetimes of β-Radioactivities. E. P. Wigner. *Phys. Rev.* 56. *pp.* 519–527, *Sept.* 15, 1939.—Two series of β-activities are considered. The first series involves nuclei in which the number n_p of protons exceeds the number n_n of neutrons by 1. The second series involves the nuclei for which $n_p = n_n$ is odd. Similarly two coupling conditions are considered: in approximation 1, the forces do not depend on either ordinary or isotopic spin. In approximation 2 only the independence of isotopic spin is assumed. Apart from these coupling conditions, no use is made of any special model. The lifetimes of the disintegrations of the first series can be calculated on the basis of either coupling condition if one adopts Fermi's original theory. The transitions of the second series are forbidden in this theory. If one adopts the modification of Fermi's theory proposed by Gamow and Teller, one can calculate the lifetimes for both series assuming the validity of the first approximation but this cannot be done if only the validity of the second approximation is assumed. The discussion of the experimental data indicates that the 1st approximation applies quite well for the normal states of nuclei up to a mass of about 30. AUTHOR.

4281. Short-Lived Radioactivities Induced in F, Na and Mg by High Energy Protons. M. G. White, L. A. Delsasso, J. G. Fox and E. C. Creutz. *Phys. Rev.* 56. *pp.* 512–518, *Sept.* 15, 1939.—On the basis of simple theoretical considerations it is expected that short-lived positron emitters should be produced in F, Na and Mg under bombardment with 6 emV protons. These activities have been found and ascribed to Ne^{19}, Mg^{23}, and $Al^{25, 26}$. Half-lives, positron spectra and threshold investigations have been made and found to compare very well with the theory. It is concluded that for isobares of the type $(n - p) = \pm 1$ the difference in binding energy is due solely to the effect of Coulomb forces up to at least mass number 25. The half-lives are found to depend on the inverse fifth power of the upper limit of the positron spectra in agreement with the theory. AUTHORS.

4282. Energies Released in the Reactions of $Li^7(p, \alpha)He^4$ and $Li^6(d, \alpha)He^4$, and Masses of Light Atoms. N. M. Smith, Jr. *Phys. Rev.* 56. *pp.* 548–555, *Sept.* 15, 1939.—The energies of the α-particles arising from the reactions $Li^7(p, \alpha)He^4$ and $Li^6(d, \alpha)He^4$ have been measured by stopping the particles in a calibrated, variable pressure, air-filled absorption cell. The use of collodion windows on the cell instead of mica, the use of thin instead of thick targets, and the prevention of the formation of oil films on the targets, were improvements in technique over the older determinations of Oliphant, Kempton, and Rutherford.

The energy release in the Li^7 disintegration was found to be 17·28 ± 0·03 eMV; that for the Li^6, 22·20 ± 0·04 emV. These new values are used, together with the energies of the Be-proton disintegrations measured with the electrostatic analyser, to set up masses for the light atoms concerned. The following values are obtained: Li^6, 6·01682 ± 0·00011, Li^7, 7·01784 ± 0·00009, Be^8, 8·00766 ± 0·00015, Be^9, 9·01486 ± 0·00013. AUTHOR.

4283. Emission of Neutrons by U. W. H. Zinn and L. Szilard. *Phys. Rev.* 56. *pp.* 619–624, *Oct.* 1, 1939.—Fast neutrons emitted by U under the action of thermal neutrons were studied by using a Ra-Be photoneutron source. The background due to the primary neutrons can be neglected since only a few of the photo-neutrons are sufficiently fast to be counted. Data are obtained concerning the energy spectrum of the U fission neutrons by recording photographically by means of a linear amplifier and kathode-ray oscillograph the pulses due to He atoms projected in an ionisation chamber. Visual inspection of the record gives an upper limit of the spectrum of 3·5 eMV. The number of neutrons emitted is estimated by analysing the pulse distribution of H atoms projected by U neutrons in an ionisation chamber filled with H_2 and A. The number found is brought into relationship with the number of fissions, observed under comparable conditions, in an ionisation chamber lined with a thin film of uranium oxide containing a known amount of U. In this way it is found that about 2·3 neutrons are emitted per fission. The method used would permit a greater accuracy in the determination of this number than the actual accuracy obtained in the present experiments. This number, together with the fission cross-section and the cross-section for radiative capture gives the number of neutrons produced for each thermal neutron absorbed in U. AUTHORS.

4284. Induced Radioactivity in Europium. K. Fajans and D. W. Stewart. *Phys. Rev.* 56. *pp.* 625–628, *Oct.* 1, 1939.—Europium oxide has been bombarded with slow neutrons from the cyclotron for periods ranging up to about five months, and with 7-eMV deuterons for much shorter lengths of time. By reduction of the Eu to its bivalent state, it has been possible to separate this element from neighbouring members of the rare-earth group. By slow neutron activation, two periods of induced radioactivity have been produced in Eu; one, with a half-life of 9·4 ± 0·2 hours, is assigned to Eu^{152}, in accordance with the results of other investigators. This isotope probably decays both by the emission of negative electrons and by the capture of K electrons. The β-spectrum, as measured in the cloud chamber, has an upper limit of 1·83 eMV. The second period, produced only after long exposure, has not decayed appreciably in six months. It has been assigned to Eu^{154}. Preliminary studies indicate that K-electron capture may also take place in the decay of this isotope. The upper limit of the β-spectrum has been found to be 1·0 ± 0·1 eMV. By relatively short deuteron bombardments, the 9-hour period has also been produced, and in addition two new periods of 12 ± 4 min. and 105 ± 5 min. have been obtained. These could not be separated from the 9-hour activity by chemical methods, which indicates that they are due also to isotopes of Eu, probably to isomeric forms of Eu^{152} and Eu^{154}, not produced appreciably by slow neutron activation. AUTHORS.

4285. Induced Radioactivity in Sr and Y; Nuclear Isomers in Sr. D. W. Stewart. *Phys. Rev.* 56. *pp.* 629–632, *Oct.* 1, 1939.—In revising and extending previous work on induced radioactivity in Sr and

Y, it was found that with stronger activation by deuterons and neutrons, more accurate determinations could be made of the radioactive decay periods, and measurements of β- and γ-ray energies could be made with greater certainty. Periods of 2·0 ± 0·2 hours, 14 ± 2 hours, and 82 ± 4 hours were found in Y separated from Sr bombarded with 7 eMV deuterons. The first of these periods was assigned to Y^{88}, and the other two either to Y^{85} and Y^{87}, or to isomeric forms of either of these. Periods of 3·0 ± 0·1 hours and 55 ± 5 days, produced in Sr by bombardment of that element with deuterons and neutrons, were assigned to the decay of isomeric forms of Sr^{89}, and the nature of that isomerism was investigated. From measurements in the cloud chamber, the maximum energy of the β-rays from the 3-hour isomer was found to be 0·60 eMV, those from the 55-day isomer had an upper limit of 1·50 eMV, and the γ-radiation which accompanied the 3-hour decay was found to have two components, of 0·55 eMV and 1·10 eMV. A tentative energy-level diagram suggests that the metastable state of Sr^{89} decays first by the emission of a β-particle and then by the emission of either one or two γ-rays. The ground state of Sr^{89} decays directly to the ground state of Y^{89} without the emission of γ-radiation.
AUTHOR.

4286. Electron and Positron Spectra of Radioactive As. W. Schaeffer and P. Harteck. *Zeits. f. Physik*, 113. 5–6. *pp*. 287–291, 1939.—The investigation of the β-ray spectrum of ${}^{76}_{33}As$ previously reported [see Abstract 3194 (1938)] is extended and the various transitions are satisfactorily included in a term scheme; the positron emission spectrum is also further examined.
J. E. K.

4287. β-Spectrum of RaE. M. Haïssinsky, S. Rosenblum and R. J. Walen. *J. de Physique et le Radium*, 10. *pp*. 355–360, *July*, 1939.—In examining the suggestion that heavy electrons are present in the β-spectrum of RaE, an apparatus is used employing crossed magnetic and electrostatic fields, while the recording photographic plate is placed at a small angle to the plane of the pole pieces of the electromagnet. By this means a substantial part of the electron trajectory can be recorded. It is shown that a trajectory, apparently due to electrons of different mass, is spurious and due to secondary emission from the edge of one of the slits of the electron gun. When such effects as this have been eliminated no evidence remains of electrons of mass other than the normal value.
G. O. B.

*4288. **γ-Ray Measurement of Ra. T. H. Oddie.** *Phys. Soc., Proc.* 51. *pp*. 905–931, *Nov.*, 1939.—In preference to calculation, experimental methods have been used for the determination of the obliquity and absorption corrections that must be applied to the measured content of a rectilinear radioactive source to find the true content. A two-stage bridge-type electrometer valve amplifier has been used to measure the ionisation current produced in a cylindrical ionisation chamber lined with brass. The effect on the corrections of variation of the following factors has been studied: (*a*) the distance between the source and the measuring instrument (from 10 to 60 cm.); (*b*) the active length of the container (from 0 to 10 cm.); (*c*) the equivalent lead wall-thickness of the cylindrical ionisation chamber of volume 1 litre (from 6 to 12 mm.); (*d*) the wall-material (Pt, Au or Ag), wall-thickness (from 0 to 2 mm.), and diameter of the Ra-container; and (*e*) the thickness of the wooden source-holder. The effect of scattered and secondary radiation upon the measurements has been found to be quite small. Percentage corrections derived from the experimental results are given in tabular form. These comprise a primary obliquity correction C_1, for the case of an unscreened source; a supplementary obliquity correction C_2, to allow for the oblique path of the measured radiation passing from the outer portions of the source through the container walls; two absorption corrections C_3, C_4, taking into account the absorption in the container wall and the source-holder respectively; and C_5, the usual correction for absorption in the radioactive salt itself. The corrections have been found to be satisfactory by an experimental measurement of the strength of a Ra container previously calibrated by the N.P.L. Additional measurements have been made to demonstrate the variation of the mass absorption coefficient of the γ-radiation with the atomic number of the material of the container screen and with the thickness of the lead filter. A description of a method of measurement of the internal diameters of cylindrical metal tubes is included. AUTHOR.

***4289. Practice and Theory of Modulation of Geiger Counters. J. N. Shive.** *Phys Rev.* 56. *pp.* 579–586, *Sept.* 15, 1939.—Experiments are described in which the behaviour of Geiger-Müller counters under conditions of l.f. and h.f. modulation was studied. The modulation was obtained by the superposition of an a.c. voltage wave upon the d.c. counting threshold. It was found that for frequencies up to about 500 kc./sec. such modulation could be successfully carried out. An analysis of the results of these experiments shows that for some counters the breakdown process can be ascribed to the liberation of electrons from the kathode by positive ion impact, while for other counters the photoelectric liberation of electrons from the kathode is predominant in the mechanism of the breakdown. Counters have been constructed for which there is evidence that both of these processes occur in the same counter. The theory of h.f. modulation of counters is discussed. AUTHOR.

***4290. Cloud Chamber with Electrical Automatic Control. F. Barendregt and G. J. Sizoo.** *Physica*, 6. *pp.* 1077–1084, *Oct.*, 1939. *In English.*—A cloud chamber is described, which can be used at variable pressures. The whole cycle of operations, required for an exposure, is made by means of electric currents. For this purpose a special switch cylinder was constructed. A method for stereoscopic photographing and for measuring the tracks is described. AUTHORS.

See also Abstracts 4194, 4413.

RADIATION.

COLORIMETRY.

4291. Rectangular Uniform-Chromaticity-Scale Coordinates. F. C. Breckenridge and W. R. Schaub. *J.O.S.A.* 29. *pp.* 370–380, *Sept.*, 1939.—The advantages and limitations of the I.C.I. coordinate system and the trilinear coordinate system yielding uniform chromaticity scales as proposed by Judd are compared. The advantages for engineering applications of a system combining rectangular coordinates with the uniform chromaticity scale (U.C.S.) are pointed out. The U.C.S. triangle is transformed to give such a system. A slight modification of the constants and a simple translation give a system of coordinates in which the first quadrant contains only greens, the second blues, the third purples and the fourth reds and yellows. The resulting diagram is compared with that obtained by MacAdam. Transformation equations for obtaining the rectangular uniform-chromaticity-scale coordinates from the I.C.I. coordinates and for the reverse transformation, the distribution coefficients for an equal-energy spectrum and for the spectrum of the Planckian radiator at 2355° K. and at 2842° K, and also the ordinates to be used in computing rectangular uniform-chromaticity-scale coordinates by the Hardy selected ordinate method for a source at 2842° K. are included. AUTHORS.

See also Abstracts 4218, 4409.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

4292. Faraday Effect and Conductivity of Electrolytic Solutions. A. Okazaki. *Ryojun Coll. Eng., Mem.* 12. *pp.* 33–43, *May*, 1939.—It is found that the equivalent percentage increments Δ of Verdet's constant ω and the rotation constant $D = (n\omega\lambda^2)/(n^2 + 2)^2$ of the solutions of alkali halides have linear relations with the degree of dissociation i or the equivalent conductivity Λ over the concentration range of $m < 6$; $\Delta = B + (A - b)\,i = B + (A - B)\,(\Lambda/\Lambda_0)$. By graphical extrapolation to $i = 1$ or 0, the values of A and B concerning ω and D are determined. The A-value of an electrolyte may be composed additively of the moduli characteristic of the component ions. The molecular rotations of the salts in dissociated and undissociated states are evaluated by using the values of A and B. AUTHOR.

4293. Faraday Effect of Strong Electrolytes in Aqueous Solutions. Part VII. A. Okazaki. *Ryojun Coll. Eng., Mem.* 12. *pp.* 45–60, *May*, 1939.—The relation between the magneto-optical rotation and the concentration of the aqueous solutions of NH_4Cl, $BaCl_2$, $NaNO_3$, KNO_3, Na_2SO_4, $ZnSO_4$ and $NaClO_4$ has been studied for D-lines. It has been found that the corrected molecular rotation $M\{D_2\}$ of the chlorides decreases with increasing concentration and that of $NaClO_4$ increases slightly, while those of the nitrates and the sulphates are nearly independent of concentration. The value of $M\{D_2\}$ in the dissociated state has been determined by graphical extrapolation to infinite dilution. By using this value of $M\{D_2\}$, the corresponding value of molecular refractivity R_2 and the ordinary dispersion data, the value of e/m for the dispersion electron, its number per molecule and the wave-length of the absorption band of these electrolytes (except for $NaClO_4$) in dissociated states have been evaluated. [For Part VI see Abstract 626 (1938).] AUTHOR.

See also Abstract 4196.

EMISSION.

4294. Cosmic Rays. Their History, Source, Nature and Effects. J. C. Stearns and D. K. Froman. *Am. Phys. Teacher*, 7. *pp.* 79–100, *April*, 1939.

4295. Very Soft Component of Cosmic Radiation. G. Bernardini and B. Ferretti. *N. Cimento*, 16. *pp.* 173–180, *April*, 1939.—In continuation of previous work establishing the presence of a very soft component of considerable intensity in the cosmic radiation, it is shown that about 90 % of this soft radiation consists of γ-rays of an energy of 5–10 eMV. This is in agreement with qualitative theoretical considerations. L. E. F.

4296. Angular Distribution of Cosmic-Ray Particles Scattered in 1 cm. of Pt. J. A. Vargus, Jr. *Phys. Rev.* 56. *pp.* 480–481, *Sept.* 1, 1939.—It is shown that the results of Anderson and of Blackett and Wilson on the scattering of cosmic-ray particles are, within experimental uncertainty, in agreement with theoretical expectation. D. H. F.

4297. Seasonal Cosmic-Ray Effects at Sea Level. R. A. Millikan, H. V. Neher and D. O. Smith. *Phys. Rev.* 56. *pp.* 487–490, *Sept.* 15, 1939.—By sending a Neher self-recording electroscope in a 10-cm. lead shield repeatedly on a slow Norwegian steamer over the route Vancouver-Los Angeles, around South America and return to Los Angeles and Vancouver, the authors found (1) as heretofore an equatorial dip measured from Los Angeles of 7 % on the western side of South America, 8 % on the eastern side; (2) no measurable seasonal effect, or winter-summer differences, at all in the voyage from Los Angeles to the Straits of Magellan; (3) as heretofore constancy in cosmic-ray intensity in summer and fall, within the limits of uncertainty imposed by fluctuations estimated at not over 1 %, on the voyage between Los Angeles and Vancouver; (4) but in winter and spring an increase of as much as 2 or 3 % between Los Angeles and Vancouver. This is interpreted as the atmospheric-temperature effect earlier studied by Hess, Compton, and their respective collaborators. AUTHORS.

4298. New Evidence for Change with Time of Total Energy Brought into the Earth by Cosmic Rays. R. A. Millikan and H. V. Neher. *Phys. Rev.* 56. *pp.* 491–493, *Sept.* 15, 1939.—In attempting to find a seasonal or winter-summer difference between the integrated value of the cosmic-ray ionisation from sea level up to the top of the atmosphere at Omaha the authors obtain much too large a difference to be interpreted as an "atmospheric-temperature," or seasonal effect, at all. By comparison with Forbush's world-wide cosmic-ray changes new evidence is found for a change with time in the total energy brought into the earth by cosmic rays. AUTHORS.

4299. Production of Hard Component of Cosmic Radiation. Part I. L. W. Nordheim and M. H. Hebb. Part II. L. W. Nordheim. *Phys. Rev.* 56. *pp.* 494–507, *Sept.* 15, 1939.—In Part I the number of quanta (and electrons) of energy k within dk times their range in units of radiation theory (photon lengths) produced in matter by a primary electron of energy E is calculated from the theory of showers to be $Z(k)dk = \alpha\ (\mathrm{E}/k^2)\ dk$, where $\alpha = 0{\cdot}57$ for quanta and $0{\cdot}44$ for electrons. With the help of the known energy distribution of the electrons coming from the outside, the energy distribution of photon lengths in the higher atmosphere is obtained. A comparison with the number and energy distribution of mesons (obtained from data near sea level and underground) leads to the following consequences of the hypothesis that the mesons are created by photons. The production process must be of moderate multiplicity and its cross-section must increase from about 1/100 of the cross-section for pair production by photons in air at moderate energy (7 to 10 eBV) to about 1/10 at higher energy (over 18 eBV). These high cross-sections required for the production of energetic mesons seem to imply correspondingly large cross-sections for absorption and constitute a serious difficulty for the understanding of their great penetrating power. In Part II the general requirements for understanding the hardening of the cosmic radiation underground together with a terrestrial origin of the hard component are discussed. It is shown that the hypotheses of photons or protons as primaries for mesons lead to the consequence that the inversion of the production processes (i.e. absorption of mesons by production of photons or protons accompanied by multiplication of the mesons) must have cross-sections smaller by a factor of order 10 compared to the production processes. As a possibility to avoid this difference, the hypothesis of neutral mesons as additional primaries is discussed. AUTHORS.

4300. Time Distribution of Cosmic-Ray Bursts. P. S. Gill. *Phys. Rev.* 56. *pp.* 632–634, *Oct.* 1, 1939.—Cosmic-ray bursts recorded with Carnegie model C cosmic-ray meters located at three widely separated stations were analysed as to their time distribution. These bursts were produced under 12 cm. of lead shielding. The results show that the cosmic-ray bursts may be considered as a random series of events. Tests for possible diurnal variations indicate systematic diurnal variations, but the data available are insufficient to make the conclusion certain. AUTHOR.

4301. Slow Mesons in Cosmic Radiation. C. G. Montgomery, W. E. Ramsey, D. B. Cowie and D. D. Montgomery. *Phys. Rev.* 56. *pp.* 635–639, *Oct.* 1, 1939.—The following experiment was performed to measure the disintegration time of cosmic-ray mesons. Mesons falling on a lead plate were detected by a layer of counters above the plate. Some of these mesons presumably stopped within the plate and a short time later emitted a disintegration electron and a neutrino. The electron would, in a certain fraction of the cases, be detected by a second layer of counters placed below the plate. Those events were recorded in which a discharge of one of the upper counters was followed by a discharge in one of the lower counters after a time t_1 and before a time t_2. In the absence of the lead plate, no disintegration electrons were expected. However, a considerable number of counter discharges were recorded which must be interpreted as the result of an intrinsic time delay in the counter between the passage of the ionising ray, and an appreciable change in potential of the counter wire. The number of disintegration electrons was measured by taking the difference in the counting rates with the lead plate present and absent. For t_1 equal to $1 \cdot 5\ \mu$ sec. and t_2 equal to $20\ \mu$ sec., 23 electrons per hour, assuming that the mean life of the mesotron is $2 \cdot 7\ \mu$ sec. were expected. A series of observations results in the measured number of $1 \cdot 4 \pm 2 \cdot 4$ per hour, a value much smaller than expected. Possible explanations of this discrepancy are discussed, the most likely one perhaps being that most mesons are absorbed by some nuclear process before they come to rest. AUTHORS.

4302. Transition Effect for Large Bursts of Cosmic-Ray Ionisation and Number of Primary Electrons of Very High Energy. C. G. Montgomery and D. D. Montgomery. *Phys. Rev.* 56. *pp.* 640–643, *Oct.* 1, 1939.—Bursts of cosmic-ray ionisation were observed in the open air and under heavy roofs, with and without a one-cm. lead plate over the ionisation chamber. The increase in the number of bursts in the presence of the lead under heavy roofs is interpreted as an increase in the number of rays in the showers from the roof, while in the open air the bursts from the lead probably originate to a large extent from the action of electrons of high energy which are not members of cascade showers starting at the top of the atmosphere. If the bursts from the atmosphere with no lead present are to be accounted for by the assumption that they are parts of extensive cascade showers, it is possible to derive the number and energy distribution of the primary cosmic-ray electrons of energies of the order of 2 × 10^{15} eV. AUTHORS.

See also Abstracts 4259, 4374 and
2418B. Sources of Light. R. Deaglio.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

4303. Phosphorescence and Fluorescence of Photographic Gelatin Films at Low Temperatures. W. Meidinger. *Phys. Zeits.* 40. *pp.* 517–518, *Aug.* 15, 1939.—At liquid-air temperatures photographic film gelatin fluoresces bright green with a bluish white phosphorescence. Addition of AgI to AgBr increases the intensity and decreases the width of the fluorescent band up to 4% AgI. Further addition of AgI decreases the intensity until with pure AgI the colour is blue-violet. The peak of the band with 4% AgI is at 5500 Å. The fluorescence first appears at − 40° C., the temperature at which the photographic sensitivity begins to decrease. J. E.

4304. Luminescence of Sulphide and Silicate Phosphors. R. P. Johnson. *J.O.S.A.* 29. *pp.* 387–391, *Sept.*, 1939.—Many features of the behaviour of luminescent sulphides can be correlated by means of a mechanism based on the energy-band theory of the solid insulator. It is imagined that after excitation, which is essentially an ionisation of an activator atom, the dissociated electron is highly likely to be trapped and held localised in a discrete energy level in the forbidden region, recombining with an ion and emitting the characteristic luminescence only after it has been freed from this trapped state by thermal excitation or other agencies. This picture, with appropriate modifications, is also useful in explaining the properties of silicate phosphors. AUTHOR.

See also Abstract 4398.

INTERFERENCE, DIFFRACTION AND SCATTERING.

See Abstracts 4230, 4316, 4369.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

4305. Phototropy of Anils. V. de Gaouck and R. J. W. Le Fèvre. *Chem. Soc., J. pp.* 1457–1465, *Sept.*, 1939.—Phototropy among anils appears to occur only in the solid state; in solution, no such changes of colour or other properties can be produced by illumination. The nature and position of substituent groups strongly influence the phototropic process. Previous explanations for this phenomenon are mentioned, and a new one advanced depending upon intermolecular resonance in the crystal lattice. The phototropic changes described in the literature for the leucocyanides of malachite- and brilliant-greens have been confirmed when alcohol is the solvent. In benzene solution, however, no phototropy has been found. The dipole moments of the two leuco-cyanides and the leuco-base of malachite-green have been determined. The values obtained illustrate the facilitation of mesomerism by the R_2N group. AUTHORS.

4306. Photosensitised Oxidation of Ammonia in Aqueous Solution by Solid Titanium Dioxide. Part I. G. G. Rao. *Zeits. f. phys. Chem.* 184. *Abt.A.* 5. *pp.* 377–384, 1939.—When *N*/5 NH_3 solution was irradiated with a Hg-vapour lamp the amount of nitrite formed was proportional to the time of illumination and was independent of the concentration of ammonia [NH_3]. Oxidation occurred at 3000 Å but not at 4050 Å.

In presence of 0·2 gm. of TiO_2 per 40 cm^3. of NH_3 solution, the rate of photo-oxidation, *r*, increased between 100 and 120-fold and was now almost proportional to $[NH_3]$ at low concentrations and independent of $[NH_3]$ at high ones. Oxidation now occurred in the visible also, even up to 4450–5000 Å. These facts are explained by an adsorption mechanism, *either* (a) (1) $TiO_2 + h\nu \rightarrow TiO_2^*$; (2) $3\ TiO_2^* + NH_3 \rightarrow HNO_2 + H_2O + 3\,TiO$; (3) $6\,TiO + 3O_2 \rightarrow 6\,TiO_2$; *or* (b) (1) $3\,TiO_2.NH_3 + h\nu \rightarrow 3TiO_2 + NH_3^* \rightarrow 3TiO + HNO_2 + H_2O$ (2) $6TiO + 3O_2 \rightarrow 6\ TiO_2$. Now $r \propto [NH_3]_{ads}$; and this, assuming a Langmuir adsorption isotherm is proportional to $[NH_3]$ for low concentrations and constant for high ones. Since TiO_2 has an absorption band at 3800 Å, the small but definite oxidation at 4050, 4359 and 5461 Å cannot be due to TiO_2 absorption alone, but may be due to the shifting of the absorption bands of NH_3 by adsorption on TiO_2 (scheme (b)). S. J. G.

4307. Photochemical Reaction between Chlorine and Chloral. W. A. Alexander and H. J. Schumacher. *Zeits. f. phys. Chem.* 44. *Abt.B.* 1. *pp.* 57–68, 1939.—The photochemical chlorination of chloral is a homogeneous reaction and proceeds almost quantitatively according to the empirical equation $CCl_3CHO + Cl_2 + h\nu \doteq CCl_4 + CO + HCl$. The rate of reaction, given by $d\,[Cl_2]/dt = k\,[I_{abs}]^{\frac{1}{2}}[Cl]$, is practically independent of chloral concentration, of total pressure and of the presence of reaction products, though towards the end of the reaction a slow reduction in pressure occurs due to the reaction $CO + Cl_2 \rightarrow COCl_2$. The reaction is a long-chain one and proceeds according to the scheme (1) $Cl_2 + h\nu = 2Cl$; (2) $Cl + CCl_3CHO = CCl_3CO + HCl$; (3) $CCl_3CO + Cl_2 = CCl_4 + CO + Cl$; (4) $2CCl_3CO = C_2Cl_6 + 2CO$. The apparent energy of activation of the whole reaction, q, is 5·4 kg.cal. For reaction (3), $q_3 \approx 6$ kg.cal. $q_2 < 6$ kg. cal.; $q_4 \sim 1$ to 2 kg.cal. The fact that O_2 hinders the reaction and causes a sensitised oxidation confirms the long-chain mechanism. S. J. G.

4308. Quantum Yield of Monochloroacetic Acid Hydrolysis. R. N. Smith, P. A. Leighton and W. G. Leighton. *Am. Chem. Soc., J.* 61. *pp.* 2295–2301, *Sept.*, 1939.—The quantum yield of the monochloroacetic acid hydrolysis is found to be considerably lower than the previously established values, and to vary with temperatures, at 2537 Å, from 0·31 at 25° to 0·69 at 69°. The yield is independent of light intensity and concentration over the ranges studied. A mechanism involving competition between deactivation and decomposition is suggested. The relation of these results to publications in which this reaction has been used as an actinometer is discussed. AUTHORS.

4309. Photodecomposition of Diethyl Ketone at Short Wave-Lengths. V. R. Ells and W. A. Noyes, Jr. *Am. Chem. Soc., J.* 61. *pp.* 2492–2496, *Sept.*, 1939.—The quantum yield of CO formation from diethyl ketone in the wave-length region 1850–2000 Å is quite high and seems to approach unity as the pressure is lowered. With an assumed quantum yield of 0·095 at 3000 Å for CO formation from acetone it has been shown that the yield from ethyl methyl ketone is only slightly higher and that that of diethyl ketone is about one. These facts indicate either a high intrinsic instability of propionyl radicals or very probable reactions involving them which lead to CO. Ethyl methyl ketone probably dissociates almost but not quite solely to give ethyl radicals in the near u.v. At short wave-lengths methyl and ethyl radicals are produced in nearly equal amounts from the primary process. Most of the ethyl radicals form butane, but a small fraction yield ethane and ethylene. AUTHORS.

4310. Image Reversal on Photobromides. Lüppo-Cramer. *Phot. Indust.* 37. *pp.* 919–922, *Aug.* 16, 1939.—The results of Arens [see Abstract 2876 (1939)] for image-reversal by the nitrite impregnation process are discussed. It is contended that the nitrite acts purely as a Br acceptor, and can be replaced by other Br acceptors, *e.g.*, SO_3'', HSO_3' or $AgNO_3$, the principle in each case being the removal of the Br formed during illumination. Mechanical prevention of the diffusion of Br is not important, since $NaNO_3$ and Na_2SO_4 have no effect in the Arens bleach process. The necessity is stressed of taking into account the additional effects of the very great illuminations employed, *e.g.*, mechanical breakdown of grains. S. J. G.

4311. Exposure for Colour. A. G. D. West. *Phot. J.* 79. *pp.* 577–584, *Sept.*, 1939.—This paper deals with the problem of obtaining correct exposure in colour photography and colour kinematography from the amateur point of view. A. H.

***4312. Development of Photomicrographic Apparatus. K. John.** *Zeits. f. Instrumentenk.* 59. *pp.* 301–314, *Aug.*, 1939.—The development of apparatus for photomicrography is traced from an early date; every improvement, either in microscopic or photographic technique, has resulted in an improvement in methods of photomicrography. The large number of factors which have contributed to the present day standard are discussed. Several modern instruments are briefly described. H. J. H. S.

See also Abstract 4303.

PHOTOMETRY.

***4313. Apparatus for Sinusoidal Permutation of Two Light Beams. E. Gambetta.** *Rev. d'Optique,* 18. *pp.* 41–56, *Feb.*, 1939.—The object of the apparatus is to solve the photometric problem of combining two light beams, whose axes intersect at right angles, so that after combination the flux in each beam varies in sinusoidal fashion, the variations being in opposite phase. This object is accomplished by means of a radially toothed disc with reflecting teeth whose plane bisects the angle between the two primary beams, and a diaphragm of special shape placed in the combined beam. The computation of the shape of the diaphragm and the practical realisation of the apparatus are described. W. S. S.

4314. Theory of the Light Field. A. Gershun. *J. Math. Phys.* 18. *pp.* 51–151, *May*, 1939.—A translation of a treatise on this subject, giving a development of the photometric theory based on the conception of the light vector. The author shows how certain photometric calculations (*e.g.*, of the illumination from a rectangular source) may be carried out very simply by using the results obtained in the development of this theory. J. W. T. W.

***4315. U.V. Photon Counters. A. Dauvillier and E. Vassy.** *Comptes Rendus,* 209. *pp.* 394–397, *Aug.* 21, 1939.—Photon counters are described which have a starting potential of about 800 V, show counting ranges of 100–200 V, and have a low zero count. According to the kathode material (seven different materials were used) and to the gas employed, the counters have their maximum sensitivity for wave-lengths of between

2200 Å and 2950 Å, while the width of the spectral interval to which they respond varies from 300 Å to 1200Å. L. E. F.

See also Abstract 4374.

POLARISATION.

4316. Extension of Krishnan's Reciprocity Law to Oblique Planes of Observation. V. S. Vrkljan. *Indian Acad. Sci., Proc.* 10*A*. *pp.* 16–19, *July*, 1939. *In German.*—An attempt is made to extend the Krishnan formulæ to oblique observation directions, no particular scattering theory being introduced. A definite formula is then obtained on the basis of Mie's theory. C. B. A.

***4317. Quarter-Wave Plates for Elliptic Analysers. J. Rabinovitch.** *Rev. d'Optique*, 18. *pp.* 81–101, *March*, 1939.—The author discusses the choice and calibration of mica lamellæ for use as quarter-wave plates in elliptic analysers. The theory of three methods for determining the wave-length for which the lamella is precisely quarter-wave is developed. These methods employ a spectrum channelled by interference bands formed by multiple reflections of the light in the lamella. The desired wave-length can be determined with a precision of 1 mμ in the visible. The determination of the neutral lines on the lamella is also described. W. S. S.

See also Abstracts 4205, 4370.

REFLECTION, REFRACTION AND DISPERSION.

4318. Photoelectric Determination of Optical Constants of Pure Metals. J. Bor, A. Hobson and C. Wood. *Phys. Soc., Proc.* 51. *pp.* 932–941, *Nov.*, 1939.—A modification of the Drude method for the measurement of the optical constants of metals is described, in which the eye is replaced by a photo-cell and the extinction position is determined objectively by means of a Lindemann electrometer. By the use of a compensating device, the inaccuracy normally resulting from unsteadiness of the light source is avoided. The results of measurements on Cu, Ni, Cr, Pd and Zn are quoted. [See following Abstract.] AUTHORS.

4319. Optical Constants of Cu-Ni Alloys. J. Bor, A. Hobson and C. Wood. *Phys. Soc., Proc.* 51. *pp.* 942–951, *Nov.*, 1939.—The paper contains experimental values of the optical constants, for the wave-length range 4000–10000 Å, of Cu-Ni alloys ranging in composition from pure Cu to pure Ni. The significance of the results is discussed briefly. [See preceding Abstract.] AUTHORS.

4320. Molar Refractivity and Parchor of α- and β-Eleostearic Acids. S. W. Wan and M. C. Chen. *Am. Chem. Soc., J.* 61. *pp.* 2283–2284, *Sept.*, 1939.—Highly purified specimens of α- and β-eleostearic acids having melting points higher than previously reported values were prepared, and their molar refractivity and parachor were determined accurately. The molar refractivity of the α acid was compared with data from other sources. For the molar refractivity and parachor of the β acid and the parachor of the α acid no previous data were available. Other physicochemical measurements are being made with both eleostearic acids. AUTHORS.

***4321. Simple Refractometer. F. Benford.** *J.O.S.A.* 29. *pp.* 352–354, *Aug.*, 1939.—The instrument described is built in the form of an attachment to be mounted on the table of a comparator made for the wave-length measurement of spectrum plates. The refractive index of a material is determined in terms of the lateral displacement obtained on viewing through a tilted, parallel-sided slab of the material. A. H.

4322. Lithium-Fluoride Quartz Apochromat. C. H. Cartwright. *J.O.S.A.* 29. *pp.* 350–351, *Aug.*, 1939.—In this lens two correcting elements of quartz are used; this, whilst not improving the achromatism, offers other advantages (1) the lithium fluoride element is completely protected from both mechanical and atmospheric damage, (2) both spherical and coma aberrations are reduced, and (3) the rotation of polarisations is practically eliminated in the quartz by the use of right- and left-hand quartz elements. A. H.

See also Abstracts 4205, 4206. 4263,

SPECTROSCOPY.

4323. Interferometer Wave-Lengths in Secondary Spectrum of Hydrogen. L. S. Combes, R. M. Frye and N. A. Kent. *Phys. Rev.* 56. *pp.* 678–679, *Oct.* 1, 1939.—Interferometer determinations have been made of the wave-lengths of 24 lines of the H_2 spectrum in the region λ4900 to λ5900, with an etalon crossed with a Littrow spectrograph. A least-squares method is described for calculating the wave-lengths. AUTHORS.

4324. Intensity Ratio of D Lines in Emission from Stationary and Moving Atoms. J. Stark and H. Verleger. *Phys. Zeits.* 40. *pp.* 518–519, *Aug.* 15, 1939.—In Na canal rays the two components have the same intensity ratio, 2·0 approximately, as in the flame. In emission from atoms at rest excited by He canal rays the ratio is 1·72 to 1·80. J. E.

4325. Excitation by Homogeneous Low-Velocity Canal Rays. F. Engelmann. *Zeits. f. Physik*, 113. 7–8. *pp.* 462–481, 1939.—Light emission resulting from collision of two corpuscular particles with energies of 1 to 10 kV is studied. The particles are generated in an arc discharge in a specially designed apparatus and are accelerated into a homogeneous beam. Collisions of neutral H atoms with He produce the Balmer lines over the whole energy range. He excitation sets in at 2000 V. H-ions give rise to intense He excitation, probably due to protons. D gives more intense excitation of He (over a certain range) than does H; but D and H excite A equally under the same conditions. These observations are in harmony with Döpel's hypothesis. C. B. A.

4326. Excitation of Green Auroral Line of Oxygen. K. G. Emeleus, R. H. Sloane and E. B. Cathcart. *Phys. Soc., Proc.* 51. *pp.* 978–988, *Nov.*, 1939.—The excitation of the green auroral line of O has been studied in a number of discharge tubes containing mixtures of A and O_2, and the early results obtained by McLennan for the optimum conditions for obtaining the line have been confirmed. It has been shown that, with discharge tubes passing heavy currents, the line is emitted mainly from an aureole surrounding the central, heavily ionised part of the gas, and the bearing of this result on the production of other forbidden lines is pointed out. The collision processes involved in the production of metastable O atoms and in the quenching of the auroral line by certain impurities have been considered, and the probable importance of resonant collisions with metastable A atoms established. AUTHORS.

4327. Isotope Displacement Effect in Tl II Spectrum. P. Köhler. *Zeits. f. Physik*, 113. 5–6. *pp.* 306–322, 1939.—New hyperfine structures and isotope displacement effects of lines in the Tl II spectrum are investigated. All the observed components are arranged in a consistent term scheme and the isotope displacements in the $6s\ ns\ {}^1S_0$ term series are found to be in satisfactory agreement with the theoretical $1/n_e{}^3$ law. The absolute isotope displacements are about twice as large as given by Breit's theory. In all cases the Tl^{203} terms lie deeper than corresponding terms of Tl^{205} as expected theoretically. J. E. K.

4328. Isotope Shift in Boron Spectrum. W. Opechowski and D. A. de Vries. *Physica,* 6. *pp.* 913–917, *Oct.*, 1939. *In English.*—A calculation of the isotope shift due to the motion of the nucleus has been carried out for the doublet B I 2497/8 Å $(3^2S_{\frac{1}{2}} - 2^2P_{\frac{1}{2},\frac{3}{2}})$. The obtained value of the " specific " shift in the sense of Hughes and Eckart is $-0 \cdot 33\ cm^{-1}$., in good agreement with the experimental value of $-0 \cdot 37\ cm^{-1}$. given recently by Mrozowski [see Abstract 2521 (1939)]. AUTHORS.

4329. Nuclear Magnetic Moments of Isotopes of Rb and Cl. P. Kusch and S. Millman. *Phys. Rev.* 56. *pp.* 527–530, *Sept.* 15, 1939. The molecular beam, magnetic resonance method has been applied to the measurement of the nuclear gyromagnetic ratios of Rb^{87}, Rb^{85}, Cl^{37} and Cl^{35}. The g values are $1 \cdot 820 \pm 0 \cdot 006$, $0 \cdot 536 \pm 0 \cdot 002$, $0 \cdot 454 \pm 0 \cdot 002$ and $0 \cdot 546 \pm 0 \cdot 002$, respectively. The magnetic moments of Rb^{87} and Rb^{85}, obtained from the observed g values and the known nuclear spins, are $2 \cdot 741 \pm 0 \cdot 009$ and $1 \cdot 345 \pm 0 \cdot 005$, respectively. The substantial agreement of the moment ratio μ_{87}/μ_{85}, $2 \cdot 038$, found by this method, with that obtained from atomic beam measurements indicates that any contribution to h.f.s. by a form of interaction between electron and nucleus not electromagnetic in character is small. A nuclear moment of $1 \cdot 365 \pm 0 \cdot 005$ is obtained for Cl^{35} if the band spectra spin value of 5/2 be taken for this nucleus. No information concerning the spin of Cl^{37} is available. [See Abstract 2090 (1939).] AUTHORS.

4330. Hyperfine Structure of Iodine Spectrum. T. Schmidt. *Zeits. f. Physik,* 113. 7–8. *pp.* 439–441, 1939.—The h.f.s. of $5p^3({}^2D)6p\,{}^3F_2$ and $5p^3({}^2D)6s\,{}^3D_2$ of I II is measured. The h.f.s. levels are found to lie in conformity with the quadratic law; the deviations from this law reported by Tolansky and explained in terms of an octopole moment of the Tl nucleus are not confirmed. J. E. K.

4331. Vector Model of the Atom and the Group of Rotations. E. Bonauguri. *N. Cimento,* 16. *pp.* 202–224, *April,* 1939.—Without employing the general methods of group theory, the author develops *ab initio* the main properties of the rotation group and shows how the results are applied in the theory of atomic spectra. W. S. S.

4332. Energy-Levels of Neon. G. Araki and Y. Yamamoto. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 461–475, *Aug.*, 1939. *In English.*—The general expression of energy-levels of an excited rare-gas atom is derived using Breit's Hamiltonian. The interactions between all electrons in the atom are taken into account. The derived expression agrees qualitatively with Laporte's formula. The numerical values of intervals between levels are computed for the configurations $1s^2 2s^2 2p^5 3s$, $1s^2 2s^2 2p^5 4s$, and $1s^2 2s^2 2p^5 8s$ of the neon. The self-consistent field radial functions computed by Brown are used for $1s$, $2s$ and $2p$. Those of $3s$, $4s$, and $8s$ are calculated from Brown's core-functions by the numerical integrations. The calculated results are given in a table. The agreement with experiment is satisfactory. AUTHORS.

4333. Method for Improved Calculation of Energies of Two-Electron Configurations from Hartree Functions : Application to $2p^2$ Terms in O III. A. F. Stevenson. *Phys. Rev.* 56. *pp.* 586–593, *Sept.* 15, 1939.—A generalisation of the method of the self-consistent field for two-electron configurations previously given by the author has now been simplified and improved in two ways. Firstly, it is now assumed that the radial functions are identical with the Hartree functions (or with simpler approximations to these), so that a considerable saving in labour results. Secondly, the core electrons are taken account of more accurately than in the original method. The final results are in general only valid if the valence electrons are equivalent or if the difference in their azimuthal quantum numbers exceeds two ; they do not involve a great deal of computation once the Hartree functions are known. Numerical calculations have been made for the normal state of He (as a test of the method) and for the $2p^2$ terms of O III. The improvement obtained with the present method, while not great, is signficant ; in particular, the separation ratio for the O III terms is markedly improved. AUTHOR.

4334. Rotation Analysis of the $a'^3\Sigma^+ \rightarrow a^3\Pi$ Bands of CO. L. Gerö and K. Lörinczl. *Zeits. f. Physik*, 113. 7–8. *pp.* 449–461, 1939.—The rotation analysis of the (8, 0) (9, 0), (10, 1) and (11, 1) bands of the $a'^3\Sigma^+ \rightarrow a^3\Pi$ band system of CO is recorded. The rotation constants obtained are in good agreement with those derived from perturbation data. Extrapolation leads to values $B_e = 1{\cdot}331$ cm^{-1}. and $\alpha = 0{\cdot}016$ cm^{-1} for the $a'^3\Sigma^+$-term. C. B. A.

4335. Methods of Calibration Used in Photographic Spectrophotometry. D. Barbier, D. Cavassilas, D. Chalonge and G. Déjardin. *Rev. d'Optique*, 18. *pp.* 142–145, *April*, 1939.—Two methods used for calibrating the plates used in the spectrophotometry of the u.v. solar spectrum have been compared. One method consists in using (in series) a number of platinised quartz plates having pronounced spectral selectivity ; the other depends on the use of diaphragms of various apertures over a lens. The two methods are found to give surprisingly concordant results. The spectral interval for which the comparison was made is 465 to 310 mμ. J. W. T. W.

***4336. Errors in Spectrophotometry Due to Imperfect Collimation and to Finite Size of Light Source. G. O. Langstroth.** *J.O.S.A.* 29. *pp.* 381–386, *Sept.*, 1939.—The Lambert-Beer relation between the transmission and the optical density of a solution holds rigidly only for an idealised optical system in which every light ray passes through the solution along a normal to cell surface. The corresponding relation for a system consisting of a line source of light (*e.g.*, a slit), a " collimating " lens, and a cell containing the solution, is shown to be of the form, $T = \epsilon^{-\mu l}[1 - \mu lk/n^2]$, where T, μ, and n, represent, respectively, the transmission, the absorption coefficient, and the refractive index of the solution, l denotes the cell depth, and k is a factor determined solely by the characteristics of the optical system. k does not vanish when a source of finite size is placed at the principal focus of the lens. In general, interpretation of observed transmission data by application of the Lambert-Beer relation does not lead to serious errors in the absorption coefficients. The error introduced in this way is a minimum for a certain lens-to-source distance which does not coincide with the focal length of the lens. A striking point brought out by the analysis is that under most circumstances it is unnecessary to use a collimated light beam in absorption coefficient measurements. The analysis suggests several features which are of interest with respect to instrument design. AUTHOR.

4337. Excited States of Hydrogen Molecule. A. Amemiya. *Phys. Math. Soc., Japan, Proc.* 21. *pp.* 394–398, *July,* 1939. *In English.*—The variational method is used to determine the energy value and other constants of certain excited states of H_2. A. H.

4338. Dispersion Due to Weak Absorption Bands. K. F. Herzfeld. *J.O.S.A.* 29. *pp.* 355–357, *Sept.,* 1939.—The evaluation of the transition probability or the electron number from absorption measurements is difficult for weak bands with background absorption. Here the formulæ are developed to evaluate this quantity from the difference in height of maximum and minimum of the dispersion curve. AUTHOR.

4339. Coriolis Coupling Terms in Polyatomic Molecules. H. A. Jahn. *Phys. Rev.* 56. *pp.* 680–683, *Oct.* 1, 1939.—A method is given by which, knowing the displacement vectors of the normal modes of vibration of any polyatomic molecule, it can be determined at once which normal modes are coupled by Coriolis forces when the molecule rotates. The water, formaldehyde, ethylene and CO_2 molecules are taken as examples to illustrate the method. AUTHOR.

4340. Zeeman Effect in Hyperfine Structure of Iodine II. A. S. Fry and R. A. Fisher. *Phys. Rev.* 56. *pp.* 669–674, *Oct.* 1, 1939.—Observations of the Zeeman effect in the hyperfine structure of I II lines at fields of 4000 to 16000 gauss provide an independent confirmation of the value 2½ units as the spin of the iodine nucleus. The patterns observed in intermediate fields have been interpreted with the help of the theory of Goudsmit and Bacher. Evidence of a nuclear quadrupole interaction is detected in some Zeeman patterns. [See following Abstract.] AUTHORS.

***4341. Hollow Kathode Source for Zeeman Effect. R. A. Fisher and A. S. Fry.** *Phys. Rev.* 56. *pp.* 675–677, *Oct.* 1, 1939.—A modification of the Schüler type of hollow-kathode discharge tube adapts it for use in magnetic fields. Details of the design and operating characteristics of the tube are discussed. [See preceding Abstract.] AUTHORS.

4342. Relative Intensities of Stark Effect Components of He Lines. L. Minnhagen. *Zeits. f. Physik,* 113. 5–6. *pp.* 292–301, 1939.—Intensities of Stark effect components of $2p$–$4q$ lines ($q = s, p, d, f$) of ortho-He are observed by the canal-ray method with perpendicular directions of canal ray, field and observation. Assuming the total intensities of p-components and of s-components of line groups $2p$–$4q$ to be independent of field strength it is found that $2p$–$4s$ and $2p$–$4d$ decrease slightly in intensity, $2p$–$4p$ increases rapidly in intensity and $2p$–$4f$ rises rapidly to a maximum as the field strength is increased up to 400 kV/cm. In general the observations are not in quantitative agreement with Foster's theory. J. E. K.

***4343. U.V. Monochromator. P. Dubouloz and H. Roux.** *Rev. d'Optique,* 18. *pp.* 146–149, *April,* 1939.—Monochromators may be used for two purposes, *viz.,* spectroscopy or spectrophotometry, and the design should depend on the purpose for which the instrument is intended. The paper describes a monochromator specially designed for spectrophotometry in the range 450 to 220 mμ, the aim having been to secure as much light as possible and to facilitate rapid adjustment; at the same time the instrument is of simple mechanical construction. J. W. T. W.

4344. Spectrometric Study of the State of Chlorophyll in Plants, in Extracts and in Pure Preparations. K. P. Meyer. *Helv. Phys. Acta*, 12. 5. *pp.* 349–392, 1939. *In German.*—Chlorophyll extracted rapidly from plants has an absorption spectrum which differs from that of pure preparations, and the difference cannot be attributed to a change in the relative proportions of the A and B forms. The "native" chlorophyll goes over into the ordinary form quantitatively with age. The spectrum of chlorophyll in the unbroken leaf is different again from that of dissolved native chlorophyll; but a colloidal solution of the latter was found to give rise to the leaf spectrum. The concentrations in plant and in the colloidal solution were the same, so that the same submicroscopic spatial arrangement of chlorophyll may be assumed to exist both in chloroplasts and in the colloid particles. C. B. A.

See also Abstracts 4254, 4255.

TRANSMISSION.

See Abstract

2330B. Light Transmission and Electric Conductance in Metallic Films. Y. Saito.

VISION.

See Abstract 4407.

X-RAYS.

4345. Influence of Temperature on Intensity of X-Ray Reflections from Different Planes of a Zn Crystal. S. Wroński. *Acta Physica Polonica*, 7. 4. *pp.* 357–366, 1939. *In German.*—The relative intensities of the X-ray reflections from different lattice planes at room-temperature and at 567° Abs. have been measured by means of the powder method, and the temperature coefficient of the intensity, M, was determined. For the amplitude of the thermal vibrations parallel, and perpendicular to the *c*-axis, the values of 0·127 Å and 0·0734 Å, respectively, were obtained at room-temperature. From these the values $\theta_{\parallel} = 200°$ Abs., $\theta_{\perp} = 347°$ Abs., are deduced for the characteristic temperatures corresponding to the same directions. L. E. F.

4346. Absorption Factor in Crystal Spectroscopy. G. Albrecht. *Rev. Sci. Instruments*, 10. *pp.* 221–222, *Aug.*, 1939.—In order to allow for the absorption of X-rays in a small crystal of volume V it is necessary in general to use the formula $I = I_0 \int_V e^{-\mu x} dv/V$, where I is the measured intensity of the diffracted beam and I_0 is the intensity which it would have possessed if there had been no absorption, x is the path length of the beam in the crystal and μ is the linear absorption coefficient. The author shows how an approximate solution of the above integral can be obtained graphically by drawing a section of the crystal to scale and subdividing it into a number of elements. The path length for each element is measured and the exponential evaluated from tables. If n is the number of volume elements considered then the above formula approximates to $I = I_0 \Sigma e^{-\mu x}/n$. J. I.

4347. Fine Structure of Dark-Light X-Ray Diffraction Line Obtained by Convergent X-Rays. T. Fujiwara. *Hirosima Journ. Sci.* 9. *pp.* 233–239, *Aug.*, 1939. *In English.*—A number of dark-light X-ray diffraction lines were found on the central black part of the radiograph taken with a thin single crystal of rock-salt by the improved method of convergent

X-rays. The results are described here, and the mechanism of the existence of these dark-light lines is also discussed. [See Abstract 2557 (1939).]

***4348. X-Ray Diffraction at Small Angles. A. Guinier.** *Ann. de Physique*, 12. *pp.* 161–237, *Sept.*, 1939.—In investigating the diffraction of X-rays, an apparatus is used by means of which intense diffraction patterns can be obtained with comparatively short exposures, using a strictly monochromatic radiation. The basis of the monochromator is a curved quartz crystal, while the rays diffracted from every point of the specimen are brought to a focus on the photographic film. All extraneous radiations have been carefully eliminated. By the use of this apparatus in studying the diffraction at very small angles from finely divided substances, such as colloidal solutions, the existence has been shown of an intense radiation at the centre of the diagram. From the curve of diffracted intensity against angle a number has been deduced which is characteristic of the mean magnitude of the elementary particle in the specimen. In the case of alloys, such as those of Cu-Al after structural hardening, the existence of an abnormal central diffracted radiation indicates the ultramicroscopic complexity of the structure. The atoms of Cu form mass planes parallel to the cube faces of the crystal of the solid solution. It is concluded that the atoms of Cu are disposed at the nodes of a lattice plane identical with the 100 plane of a crystal of Al. G. O. B.

4349. Theory of Diffuse Scattering of X-Rays by Crystals in Region of K Critical Absorption Wave-Length. G. E. M. Jauncey. *Phys. Rev.* 56. *pp.* 644–651, *Oct.* 1, 1939.—The scattering of X-rays according to the classical theory from a bound electron of natural frequency ν_q is first considered. Then Z electrons with various ν_q's are assembled into an atom and the scattering from the atom studied. The scattered rays are separated into coherent and incoherent parts by a study of the interference between the scattered rays from two similar atoms. From this S_{coh} and S_{incoh} are obtained for the atom. Kramers, Kallmann and Mark's idea of virtual oscillators is used so that S_{coh} and S_{incoh} are averaged for the distribution of oscillators. The λ^3 absorption law suggests either $2\nu_K^2\nu_q^{-3}d\nu_q$ or $4\lambda_K^{-4}\lambda_q^3 d\lambda_q$ as the fraction of oscillators with frequencies between ν_q and $\nu_q + d\nu_q$ or with wave-lengths between λ_q and $\lambda_q + d\lambda_q$. In determining the averages it makes a difference which distribution is used. The theory gives $S_{\text{coh}} + (f - \Delta f)^2 \times (1 - e^{-2M})/Z$, where Δf is the atomic structure factor decrement and e^{-2M} the Debye-Waller temperature factor. Also the theory gives $S_{\text{incoh}} = 1 - (1/Z)\Sigma E_r^2 + Y$, where Y is negligible for $\lambda > \lambda_K$ but is quite large for $\lambda < \lambda_K$. Its size when $\lambda < \lambda_K$ suggests that Y is the classical analogue of the energy which goes into the K fluorescent rays. Since these rays are removed by absorption in Al in experiments on diffuse scattering, Y is omitted in S_{incoh}. Finally $S = S_{\text{coh}} + S_{\text{incoh}}/\{1 + (h/mc) \text{ vers } \phi\}^3$. Hönl's theoretical value of $\Delta f = 2{\cdot}3$ is compared with McNatt's experimental value $2{\cdot}5$ for Cu Kα X-rays scattered by Zn. AUTHOR.

4350. Discontinuities of K-Absorption of La, Ce, Pr, Nd, Sm. M. Rouault. *Comptes Rendus*, 209. *pp.* 434–436, *Sept.* 4, 1939.—The rare earths have a great theoretical interest on account of their characteristic electronic structure. The discontinuities of the K-absorption of the elements La, Ce, Pr, Nd and Sm were measured. The most suitable thickness of the absorbing films having been calculated by Sandström's formula, according to Jönsson's laws of absorption the author verified experimentally the thickness which was calculated. The radiation was analysed by means of a Cauchois spectrograph with curved mica. The plane 201 of the mica gave a dispersion of 12·8 *u*X per mm. in the first order. With a tension of 85 to 90 kV and an electronic output of 8 to 16 mA the times of keeping in the fixed position which are most suitable are two hours. For continuous background for La and Ce an anti-kathode of Cu covered with a thick electrolytic deposit of Au was used, and for the other substances an anti-kathode of W. A table is given containing the numerical results of the various experiments. J. J. S.

4351. X-Ray Absorption Edges of Gaseous, Liquid and Solid $GeCl_4$. T. Dryński and R. Smoluchowski. *Physica*, 6. *pp.* 929–940, *Oct.*, 1939. *In English.*—The aim of this investigation was to compare the fine structure of the X-ray absorption edges in gaseous, liquid and solid states. As absorbing substance $GeCl_4$ was chosen since the structure of the GeK-edge of this molecule is well known theoretically and experimentally. Special arrangements have been developed in order to obtain a thin layer of absorbing substance in the liquid (room-temperature) and in the solid (melting point − 52° C.) state. The structure of the Ge-edge of solid $GeCl_4$ differs considerably from that obtained with both liquid and gaseous $GeCl_4$, the structure in the two latter states being practically identical. The results are in accord with general qualitative expectations which can be formulated in considering the essential characteristic features of the gaseous, liquid and solid states. AUTHORS.

HEAT.

CALORIMETRY.

See Abstract 4275.

CONDUCTION.

4352. Periodic Flow of Heat in a Hollow Cylinder. J. H. Awbery. *Phil. Mag.* 28. *pp.* 447–451, *Oct.*, 1939. The problem of the flow of heat in a hollow cylinder, when the temperature of the inner wall is constrained to vary periodically, and the heat loss from the outer surface is proportional to its temperature excess over the surroundings, is investigated mathematically. The theory has applications to the heat phenomena in the cylinder of an engine, and would also be needed in determining the thermal diffusivity of a metal experimentally by measurements of temperature waves in a hollow rod. The various Bessel functions occurring in the solution are complex numbers, though the expressions for such physical quantities as the amplitude and phase lag reduce to real numbers. The formulæ are written (in terms of the real and imaginary parts of the Bessel functions) so as to exhibit these quantities in a purely real form.

AUTHOR.

4353. Accommodation Coefficient of He on Ni. B. Raines. *Phys. Rev.* 56. *pp.* 691–695, *Oct.* 1, 1939.—The thermal accommodation coefficient of He on gas-free " A " nickel was measured at the temperature

90, 195, 273 and 369° K., and was found to be 0·048, 0·060, 0·071 and 0·077, respectively (± 0·004). In the presence of the gas the accommodation coefficient rose rapidly to the equilibrium values 0·413, 0·423, 0·360 and 0·343, respectively (± 0·012). Using the theory of A. F. Devonshire [see Abstract 406 (1937)] and the observed values of a_0, calculations were made of the two constants of the interaction potential between a He and a Ni atom. The results obtained were $\kappa = (0{\cdot}75 \pm 0{\cdot}05) \times 10^8$ cm^{-1}. for the exponential decay constant, and D = (430 ± 60) cal./mol for the heat of adsorption of He on Ni. At the two lower temperatures the thermal conductivity of " A " nickel was measured. The values obtained were (0·74 ± 0·04) watt/cm^2./deg. at 90° K., and (0·71 ± 0·04) watt/cm^2./deg. at 195° K. AUTHOR.

4354. Theory of the Senftleben Effect. F. Zernike and C. van Lier. *Physica,* 6. *pp.* 961–971, *Oct.,* 1939. *In English.*—Gorter's qualitative explanation of the Senftleben effect by the influence of the magnetic precession on the mean free path is worked out in a quantitative way. The observed difference between the longitudinal and transverse effects can thus be explained as well as their dependence on the magnetic field. [See Abstract 502 (1938).] AUTHORS.

***4355. Precise Method of Measuring Heat Conductivity Applicable to Either Molten or Solid Metals. Thermal Conductivity of Zinc. C. C. Bidwell.** *Phys. Rev.* 56. *pp.* 594–598, *Sept.* 15, 1939.—A metal rod or a hollow vertical graphite cylinder containing molten metal is packed in silocel contained in an outer iron cylinder. Downward heat is established, and vertical gradients are measured differentially by thermojunctions in quartz tubes as are also radial temperature drops across the silocel at all levels. At low temperatures the iron cylinder is surrounded by constant temperature baths, at high temperatures by additional silocel contained in magnesia pipe lagging. The differential junction measurements were obtained by raising one junction progressively while the other was left at the bottom. High temperatures were obtained by a heater winding placed directly on the specimen or graphite cylinder but insulated electrically. For either low or high temperature arrangements the gradient down the specimen is found to change with distance at a constant rate. This means that radial temperature drops across the silocel are constant from bottom to top. This was checked experimentally. Previously published values for solid zinc are verified and extended through the melting point to 730°. The drop in conductivity at the melting point agrees with data of Konno (the only data found in the literature). The values in the liquid state decrease slightly with rise of temperature. Konno's data suggested this but did not extend far enough to prove it [see Abstract 583 (1920)]. AUTHOR.

CONVECTION.

See Abstracts 4184, 4185.

DILATATION.

See Abstract 4359.

TEMPERATURE.

***4356. Vacuum Thermoelement. I. Amdur and H. Pearlman.** *Rev. Sci. Instruments,* 10. *pp.* 174–175, *June,* 1939.—A thermoelement intended for use with molecular beams, but suitable for radiation measurements is made of a single junction of constantan and Chromel P. which gives a sensitivity of 60 μV/°C. at room-temperature. The thermoelement is surrounded by a cylindrical Cu radiation shield, which is covered by 3 layers of bakelite lacquer and provided with a heater and thermoelement for temperature control. The wires are joined to a Pt receiver, blackened with aquadag. A second constantan wire is attached for control purposes. If H_2 of a pressure of 10^{-4} mm. is introduced the sensitivity to radiation is reduced by less than 1%. The voltage is, with very high accuracy, proportional to the radiation intensity. R. P.

See also Abstracts 4243, 4366, 4373.

THERMOCHEMISTRY.

See Abstract 4278 and

2275B. Lowering of Flashpoint of Mineral Oil by Supersonic Waves. G. Sadakiyo and T. Siraisi.

THERMODYNAMICS.

4357. P.V.T. Diagram of Allotropic Forms of Ice. F. L. Verwiebe. *Am. Phys. Teacher,* 7. *pp.* 187–189, *June,* 1939.—The P.V.T. diagram suggested for the allotropic forms of ice has been constructed from the data of Bridgman [see Abstract 781 (1938)]. It is a 3-dimensional isometric projection of the thermodynamic surface of water in its stable liquid and solid phases. The volumes indicated are those for 1 kg. of water at temperatures ranging from − 40° to 110° C. and at pressures from zero to 25000 kg. per cm^2. Several interesting features concerning the properties of water are discussed in connection with the diagram. R. W. P.

4358. P.V.T. Relations for Gaseous Monomethylamine. C. T. Kenner and W. A. Felsing. *Am. Chem. Soc., J.* 61. *pp.* 2457–2459, *Sept.*, 1939. The P.V.T. relations for gaseous monomethylamine have been measured over a temperature range of 60 to 225°, a specific volume range of approximately 27 to 107 cm^3./gm., and a pressure range of approximately 7·5 to 38 atm. An equation of the Keyes type has been fitted to these data; this equation is $p = RT/(v - \delta) - 17940/(v + 1{\cdot}759)^2$, where $\log_{10} \delta = 1{\cdot}0548 - 6{\cdot}120/v$. This equation reproduces the observed pressures satisfactorily. AUTHORS.

***4359. P.V.T. Relations in Solutions. Part II. R. E. Gibson and O. H. Loeffler.** *Am. Chem. Soc., J.* 61. *pp.* 2515–2522, *Sept.*, 1939.—From measurements of the specific volumes at 25°, the thermal expansions and the compressions of aniline, nitrobenzene, chlorobenzene and bromobenzene, a table of the volumes of these liquids at any temperature and pressure in the region 25 to 85° and 1 to 1000 bars has been compiled. Suitable equations for computing the first and second derivatives also are given. From these data the coefficients $(\partial P/\partial T)_V$ and $(\partial E/ V)_T$ were computed. The variation of these and other thermodynamic functions with temperature at constant volume is discussed. Both $(\partial P/\partial T)_V$ and $(\partial E/\partial V)_T$ decrease as the temperature increases at constant volume. It is suggested that this effect is due to an increase in the repulsive internal pressure which follows from an increased randomness in the distribution of the molecules in the liquids at higher temperatures. The quantity (B + P) in the Tait equation for the compressibility of the liquids is identified empirically as the repulsive internal pressure. It increases with temperature at constant volume and, when it is combined with the total internal pressure, an estimate of the attractive pressure is made. The attractive pressure so computed is expressible as $P_A = a'V^{-n}$ and is dependent only on the volume within the limits of experimental error. The exponent n has the value 3 for benzene and 2·74 for the polar liquids. A weight dilatometer of vitreous silica suitable for the rapid and precise measurements of the thermal expansions of solutions is described. [For Part I see Abstract 1731 (1939).] AUTHORS.

4360. Pd-D_2 Equilibrium. L. J. Gillespie and W. R. Downs. *Am. Chem. Soc., J.* 61. *pp.* 2496–2502, *Sept.*, 1939.—The isotherms of Gillespie and Galstaun for Pd and H_2 at 250 and 280° have been confirmed. A series of isotherms for D_2 and Pd black has been obtained from 200 to 300°, including a critical solution point. A difficulty due to reluctance to formation of the second solid phase was overcome by first forming the β phase of H_2-Pd by pretreatment with H_2. After such pretreatment the isotherms of D_2 are thoroughly reproducible, and after prolonged treatment of Pd with D_2 the H_2 isotherms are again reproducible. For a given temperature and pressure, the absorption of D_2 is less than that of H_2, but at all the temperatures studied there is not much difference in the maximum absorption of the two gases at the highest practicable pressures after the second solid phase has been formed. Horizontal lines appear in the D_2 isotherms at pressures about 2·3 to 2·5 times the pressures of the corresponding hydrogen horizontals. The critical solution temperature for D_2 and Pd is found to be 276°, the critical pressure 35 atm., and the critical composition 0·25 atom D per atom Pd. The heat of solution per mole of D_2 increases regularly with increasing D_2 content and is 7760 cal./mole for the conversion of the first to the second solid phase. The phase diagram is given. The locus of the compositions of coexistent solid solutions is smooth and continuous without rising steeply at any simple atomic ratio. This indicates that no Pd deuterides exist in the region above 200°. As the composition of the second solid phase is practically that of Pd_2D at 200° (like the H_2 system), further work at lower temperatures will be required to determine the posssible existence of this compound. The Pd black was prepared by reduction of palladosammine chloride and studied at once. AUTHORS.

4361. Structure of Binary Systems. E. Jänecke. *Zeits. f. phys. Chem.* 184. *Abt.A.* 5. *pp.* 373–376, 1939.—A recent paper by Vogel [see Abstract 1299 (1939)] is discussed. This deals with the validity of the phase rule, and the main question is the conditions necessary for equilibrium. A number of examples are given and the paper includes a large Bibliography. E. H. D.

4362. Thermodynamics of Propylene. T. M. Powell and W. F. Giauque. *Am. Chem. Soc., J.* 61. *pp.* 2366–2370, *Sept.*, 1939.—The heat capacity of solid and liquid propylene has been measured from 14 to 226° K. The melting and boiling points are 87·85 and 225·35° K., respectively. (0° C. = 273·10° K.) The heats of fusion and vaporisation were measured calorimetrically and were found to be 717·6 and 4402 cal./mole, respectively. The vapour pressure of propylene was measured from 165·8 to 225·9° K. and the results have been represented by the equation $\log_{10}P_{(\text{inter. cm. Hg})} = -1196{\cdot}9/T - 3{\cdot}92 \times 10^{-3}T + 8{\cdot}07544$. The gas density of propylene was determined to be 1·7461 gm./l. at 25·00° C. and 1 atm. The calorimetric data have been used to calculate the entropy of propylene gas and the value at the boiling point was found to be 59·93 cal. deg.$^{-1}$ mole^{-1}. The value calculated for this temperature from available molecular data is 61·0 ± 0·3 cal. deg.$^{-1}$. mole^{-1}. The entropy discrepancy is interpreted as due to random end for end orientation of $CH_2 = CH - CH_3$ molecules in the crystal lattice. It is concluded that unsymmetrically placed double bonds in otherwise symmetrical hydrocarbons will lead to a disordered arrangement in the crystal lattice and a suitable entropy correction should be made to the $\int C_p \, d \ln T$. The most reliable value for the entropy of propylene gas at 298·1° K. and 1 atm. is 64·0 cal. deg.$^{-1}$ mole^{-1}, calculated from molecular data. AUTHORS.

4363. Thermodynamic Properties of TiO_2. H. J. McDonald and H. Seltz. *Am. Chem. Soc., J.* 61. *pp.* 2405–2407, *Sept.*, 1939.—The heat capacity of TiO_2 (rutile) is determined from 68–298° K. The entropy is computed from these measurements and found to be 12·45 e.u. at 298·1° K. The thermodynamic properties of TiO_2 are evaluated, and applied to the problem of the deoxidation of steel by Ti. AUTHORS.

4364. Quantum-Mechanical Considerations in Theory of Reactions Involving Activation Energy. J. O. Hirschfelder and E. Wigner. *J. Chem. Phys.* 7. *pp.* 616–628, *Aug.*, 1939.—The activated complex or transition state method for calculating the absolute rate of a chemical reaction with an activation energy would be rigorously valid if classical mechanics applied to all degrees of freedom. Quantum mechanics involves two kinds of limitations; one because of Heisenberg's uncertainty principle, and the other because a wave packet can be reflected on its way both up and down the potential barrier separating the initial and final states. Thus the transmission coefficient is often a rapidly fluctuating function of the energy of the system, but for a temperature distribution of the energy covering several periods of this fluctuation an average transmission coefficient can be defined agreeing nearly with the classical value. In problems with several degrees of freedom the coefficient is affected by the interchange of translational and vibrational energy, but if the vibrational motion is fast compared with the motion along the reaction path, these degrees of freedom can be treated on a par with the electronic coordinates, and Eyring's formulæ are satisfactory. It is concluded that quantum mechanical considerations invalidate the transition state method to a lesser extent than expected, and may be important only in the consideration of the relative rates of reactions between isotopes and reactions at very low temperatures. N. M. B.

See also Abstracts 4231, 4239.

VAPORISATION AND CONDENSATION.

***4365. Reflux Regulator and Head for Laboratory Rectifying Columns. F. D. Rossini and A. R. Glasgow, Jr.** *Bureau of Standards, J. of Research*, 23. *pp.* 509–514, *Oct.*, 1939.—A reflux regulator and head for laboratory rectifying columns is described that (*a*) has a non-lubricated glass valve, (*b*) utilises a minimum of height above the rectifying section of the column, (*c*) provides for a substantially constant rate of removal of distillate for each setting of the valve, (*d*) provides for estimation of the "throughput" and the reflux ratio, (*e*) provides space for a thermometric device, and (*f*) has a flexible metal partition for permitting distillation at pressures below or above the prevailing atmospheric pressure. AUTHORS.

***4366. Expansion Liquefier for Helium. A. H. Cooke, B. V. Rollin and F. Simon.** *Rev. Sci. Instruments*, 10. *pp.* 251–253, *Sept.*, 1939.—A short description is given of an expansion liquefier which yields a supply of liquid He in a Dewar vessel and is very economical in liquid H_2. AUTHORS.

4367. Vapour Pressure of Aqueous Solutions of H_2SO_4. S. Shankman and A. R. Gordon. *Am. Chem. Soc., J.* 61. *pp.* 2370–2373, *Sept.*, 1939.—The vapour pressure of H_2SO_4 solutions at 25° has been measured by the static method for concentrations ranging from 2 to 23 molal. The results are in good agreement with the vapour pressure measurements of Grollman and Fraser, and are consistent with the vapour pressure measurements of Collins up to 8 molal. They agree with the results of e.m.f. measurements up to 3 molal, but are in definite disagreement at higher concentrations. Values of the activity of the water and of the activity coefficient of the acid in the solutions have been tabulated at round values of the concentration. AUTHORS.

4368. Vapour Pressure Formula for High Temperatures. H. Scheffers. *Zeits. f. phys. Chem.* 44. *Abt.B.*1. *pp.* 53–56, 1939.—A consequence of the use of the Debye theory in the range of high temperatures is the establishment of the validity of the vapour pressure formula. The part which depends on the temperature contains only the known vapour pressure constant and the characteristic temperature. These can be directly determined from vapour pressure measurements and the method is illustrated by examples taken from the literature. E. H. D.

See also Abstracts 4186, 4206, 4207, 4361.

ACOUSTICS.

4369. Dispersion of Supersonic Waves in Liquids. L. Zachoval. *J. de Physique et le Radium*, 10. *pp.* 350–354, *July*, 1939.—By a similar method [see Abstract 1745 (1939)], described in detail, the velocities of supersonic waves in acetone, methyl acetate, nitrobenzene, toluene, carbon tetrachloride and glycerol, were determined for frequencies of from 999·800 to 9994·500 kc./sec. at approximately 27·8°, and in castor oil at 18·1–18·5°. In glycerol and toluene velocity decreases with increase of frequency, and probably also in nitrobenzene; in castor oil it decreases with rise in temperature. Previous results are compared. C. A. S.

4370. Influence of Supersonic Vibrations on Rotatory Power of High Molecular Substances. Part II. Tannin Solutions. N. Sata. *Kolloid Zeits.* 88. *pp.* 182–184., *Aug.*, 1939.—Rotation measurements have been carried out with solutions of tannin in water and alcohol by the procedure previously described [see Abstract 2962 (1939)], and these exhibited no alteration under the influence of supersonic vibrations; appreciable colour and turbidity effects, however, were observed. A control experiment *in vacuo* established that the latter changes were due to atmospheric O_2 which had been activated by the supersonic vibrations. Comparison with similar experimental data from gelatin has shown that the supersonic vibrations cannot exert any influence on the rotation of tannin solutions, because of the thin though strong hydration layer on the tannin. H. H. Ho.

***4371. Thyratron Inflection Indicator for Teaching the Deaf. T. A. Sterne and H. J. Zimmermann.** *Journ. Sci. Instruments*, 16. *pp.* 334–336, *Oct.*, 1939.—In an instrument designed for making pitch variations visible, sound impulses are fed to an electronic frequency meter the output of which is directly proportional to the fundamental frequency. The amplified voltage is applied to the grids of seven thyratrons, which are biassed by successively greater amounts. The number of thyratrons which fire at any given signal therefore depends on the frequency of the signal. The firing of each thyratron lights a neon lamp in its plate circuit, and since these lamps are arranged in a vertical column, the effect obtained is of a column of light which rises and falls with rising and falling pitch. The device presents visually the concept of pitch change and greatly facilitates instruction in voice control. AUTHORS.

4372. Transmission of Sound Through Thin Plates. F. H. Sanders. *Canad. J. of Research*, 17. *Sect. A. pp.* 179–193, *Sept.*, 1939.—The transmission of h.f. sound through plates of brass and nickel has been studied for angles of incidence ranging from 0 to 70°, using effective plate thicknesses varying from $\lambda/20$ to λ. In addition to strong transmissions in the region below the normal critical angle, very sharp and intense transmission maxima are observed at angles of incidence greatly in excess of the critical angle. These transmission maxima fall within three clearly defined angular regions: (i) angles between zero and the critical angle for longitudinal waves; (ii) angles between the critical angle for longitudinal waves and the critical angle for transverse waves; and (iii) angles above the critical angle for transverse waves. In regions (i) and (ii) the observed data are in satisfactory agreement with a recent theory advanced by Reissner, and good values of the elastic constants are obtained. By an extension of Lamb's theory for flexural vibrations in bars the results in region (iii) can be interpreted. AUTHOR.

See also Abstracts

2275B. Lowering of Flashpoint of Mineral Oil by Supersonic Waves. G. Sadakiyo and T. Siraisi.
2347B. Measurement of Sound Intensity under Water by Resonance Disc. T. Hayashi.
2425B. Theory of the Telephone Receiver. A. Ferrari-Toniolo.
2458B. Radiation of Sound. T. van Urk and R. Vermeulen.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

See Abstracts 4377, 4381 and

2311B. Equivalence of Electrical Networks. G. Calabrese.
2321B. Capacitance-Resistance Potentiometer Independent of Frequency. O. Zinke.

CONDUCTION AND DISCHARGE IN GASES.

4373. Temperature of High Pressure Arcs. C. G. Suits. *J. of Applied Physics*, 10. *pp.* 728–729, *Oct.*, 1939.—From measured values of arc gradient E (V cm^{-1}.) and current density I (A cm^{-2}.) the arc temperature is calculated for nitrogen in the pressure range 1–30 atm. and current range 1–10 A, and in hydrogen at 1 atm. pressure for the current range 1–10 A. [See Abstract 5141 (1935).] AUTHOR.

✱4374. Current Densities, Lumen Efficiency and Brightness in A, N_2, He and H_2 Arcs. C. G. Suits. *J. of Applied Physics,* 10. *pp.* 730–732, *Oct.,* 1939.—From oscillographic records of arc diameter D, gradient E, current *i*, and comparative brightness data, the lumen efficiency and current densities are determined for the positive column of arcs in A, N_2, He and H, in the pressure range between 1 and 100 atm. AUTHOR.

4375. Theory of Magnetic Effects in Plasma of Arc. L. Tonks. *Phys. Rev.* 56. *pp.* 360–373, *Aug.* 15, 1939.—The equations governing electron drift in the presence of a magnetic field are applied to the low pressure uniform positive column plasma with reference to electron concentration and the effect of a longitudinal magnetic field. With the latter the plasma exhibits a diamagnetic susceptibility proportional to the electron current density to the tube walls, in agreement with theory. With non-conducting walls the magnetic polarisation varies through a maximum beyond which the plasma is paramagnetic for small variations in the field. The magnetic field of the arc itself has a concentrating pinch effect, favoured by large diameter arc columns and higher pressures, which would cause infinite axial concentration of electrons at a finite arc current if other limitations did not intervene. This may be the cause of rapidly increasing arc gradients at critical currents in large Hg arc rectifiers. N. M. B.

4376. Sparking Potential in D_2 and H_2. A. Leemann. *Helv. Phys. Acta,* 12. 5. *pp.* 397–414, 1939. *In German.*—To a first approximation the minimum sparking potential of a gas is equal to the corresponding normal kathode fall. Güntherschulze has found a distinct difference of the normal kathode fall in H_2 and D_2 and hence an investigation was made of the sparking potentials in these gases. Homogeneous electric fields were used with electrode distances from about 2·5 to 5 mm. and the pressures ranged from about 2 to 30 mm. Hg. This corresponds to a pressure-distance range of $p.l = 6{\cdot}5$ to 145 mm. Hg. mm. The curves obtained show a minimum sparking potential of 249 V for H_2 and 268 V for D_2, these being found at $p.l$ values of 10·5 and 12·3 respectively. Güntherschulze's values for the normal kathode fall in H_2 and in D_2 are 260 V and 284 V, the ratio being 0·92. The ratio of the minimum sparking potentials now obtained is 0·93. Agreement of the absolute values is not to be expected since in the two sets of measurements essentially different space-charge conditions exist. Putting Townsend's ionisation coefficient (a) for electrons into the form given by Schumann $a = p.c_1.\ e^{-c_2.\pi/V}$ where $\pi = p.l$, the constant $C_2 = (V/\pi)_{\min}$. The value of C_2 can be found directly when π/V is plotted against log π. Up to about $3\pi_{\min}$. the graphs thus obtained are straight lines, but beyond this point they curve upwards. The value of C_2 is found to be 23·8 for H_2 and 21·9 for D_2. A. W.

See also Abstracts 4289, 4290, 4325, 4326 and
2302B. Ignition Potential Variation with Technical Spark Gaps. W. Fucks and H. Bongartz.

CONDUCTION IN SOLIDS AND LIQUIDS.

✱4377. Moving-Iron Vibration Galvanometer. W. Rump. *Phys. Zeits.* 40. *pp.* 493–500, *Aug.* 1, 1939.—A moving-iron vibration galvanometer is described, in which the a.c. to be measured flows through a coil wound on nickel-iron stampings. The coil is situated behind a magnetised needle with mirror which is suspended between the poles of a d.c. electromagnet. The variation of magnetic field produced when a.c. flows sets up vibration in the needle. The current and voltage sensitivities are given as 5×10^{-9} A and 5×10^{-7} V, per mm. deflection at 1 m. distance. A portable form of galvanometer is also described. E. R.

4378. Conductivity of Uni-Univalent Salts in Acetone. J. F. J. Dippy, H. O. Jenkins and J. E. Page. *Chem. Soc., J. pp.* 1386–1391, *Sept.*, 1939.—Conductivity measurements have been made upon seven uni-univalent salts in acetone, and a diversity of results has been obtained. The $\Lambda - \sqrt{c}$ curves for NaI and KI show good agreement with Onsager's prediction at low concentrations, and Λ_0 values have been derived by extrapolation. With other salts, *e.g.*, sodium and potassium salicylates, curves of entirely different type have been obtained. The results as a whole are believed to be consistent with the general conductivity curve whose form is determined by considerations of interionic attraction and ion association. Calculations involving the data for the less highly dissociated salts show that here ion-duplet formation is governed largely by the mass-action law. AUTHORS.

4379. Electrical Resistance under Varying Conditions of Glasses and Porcelains of Possible Utility for Commercial Insulators. E. Seddon, W. J. Mitchell and W. E. S. Turner. *Soc. Glass Technol., J.* 23. *pp.* 197–238, *Aug.*, 1939.—On twenty different glasses and nine porcelains (glazed and unglazed), in the form of short rods, systematic measurements were made of the volume resistivity *in vacuo* and of the surface resistivity under varying conditions, including temperature and humidity variation, and exposure, for varying periods of time extending to 1 yr., to weathering in the atmosphere of a heavily industrialised neighbourhood. Measurements on the weathered specimens were also made after the application to them of mechanical and chemical cleaning processes. The degree of reproducibility of results was studied in detail. Wide variations in the surface resistivity of different specimens was the general experience whether after exposure to the ordinary atmosphere or to pure water vapour in a closed chamber. The volume resistivity values of different specimens of any one material examined *in vacuo* were in close agreement and remained practically constant with time; and the very varying resistivities of individual specimens were brought much closer together when treated in a closed space which could be evacuated, thus showing the dominating effect of the film of moisture or dissolved electrolyte, the various forms of deposit losing potency in the absence of moisture. It was shown that a wide range of suitable glasses is available to meet the electrical requirements of telephone and telegraph insulators. AUTHORS.

See also Abstract 4220 and

2297B. Theory of Electrolytic Conduction. S. Kaneko.
2324B. Electron Tube D.C. Voltmeter of New Design. R. L. Garman and M. E. Droz.
2327B. Electrostatic Measurement of Voltage. J. Müller-Strobel.
2330B. Light Transmission and Electric Conduction in Metallic Films. Y. Saito.
2400B. Copper-Oxide Rectifier. L. Dubar.

DIELECTRICS AND CAPACITANCE.

4380. Dielectric Properties of Carbohæmoglobin Solutions with Added Impurities. S. Arrhenius. *Phys. Zeits.* 40. *pp.* 534–539, *Aug.* 15, 1939.—The dielectric properties of carbohæmoglobin solutions to which glucose, glycerin, urea or glycocoll have been added, are investigated at wave-lengths between 90 and 3000 m. In all cases the dipole moment is found to be smaller than that previously obtained for solutions in water. The relaxation time is also found to be smaller than the calculated value, particularly for the solutions to which glucose and glycerin are added, and an explanation is suggested for this difference. E. R.

4381. Dielectric Constants of Organic Liquids at Radio Frequencies. Part III. Theoretical. Part IV. Experimental. R. M. Davies and T. T. Jones. *Phil. Mag.* 28. *pp.* 289–327, *Sept.*, 1939.—A continuation of the work described in two previous communications which dealt with liquids having dielectric constants varying from about 2·2 to about 10·4. In the present papers the range is extended to about 34 to 81. The method adopted is that of comparison and is essentially the same as described previously, namely, the use of a resonant circuit at radio frequencies. Part III deals with the detection of resonance, the effect of lead inductance, and the calculation of the resonance condition with the capacitance potential divider. Part IV relates to the purification of materials, experimental results, discussion of the results and comparison with those of previous investigations. Whilst the results obtained are in close agreement as between themselves there are considerable differences in the values obtained by different observers. It is thought that these may be due to the neglect of lead inductance correction which must become very important at the frequencies used by the other investigators. [For Part II see Abstract 2843 (1936).] S. A. S.

4382. Solvent Effect in Dipole Moment Measurements. M. E. Hobbs. *J. Chem. Phys.* 7. *pp.* 849–850, *Sept.*, 1939.—Müller and others have definitely established the existence of a solvent effect in dielectric polarisation measurements. The effect has been shown to influence only the orientation polarisation. Thus the molar orientation polarisation of nitrobenzene measured in benzene is 330 cm^3. whereas it is 380 cm^3. if measured in the gas state. Considerable work has been done on this problem both theoretically and empirically. In general, however, the actual application of solvent effect corrections has been largely of an empirical nature. A new and promising theoretical approach is offered by the use of the Onsager reaction field, the equation for which is applied to an expression given by Böttcher for the molar orientation polarisation. A table is given showing a comparison of Müller's observed values and values calculated from a new formula given in the paper, for various solvents and agreement between the two is considered satisfactory. S. A. S.

4383. Electrical Properties of Solids. Parts IV and V. R. M. Fuoss. *Am. Chem. Soc., J.* 61. *pp.* 2329–2340, *Sept.*, 1939.—The electrical properties of polyvinyl chloride plastics depend on thermal history. Increased time and temperature of heating give increased d.c. conductance. The amount of pyrolysis can be followed by adding a soluble lead compound such as lead abietate to the plasticiser and determining the conductance for various heating times and temperatures. The dielectric constant changes with time in a way which suggests a relaxation mechanism. There is a one to one correlation between d.c. conductance, dielectric constant and loss factor. In Part V dielectric constants and loss factors at 40° and 20 ∼ to 10 kc./sec. under low voltage are reported for the system polyvinyl chloride-tricresyl phosphate, over the entire concentration range. As a function of composition, the maximum absorption and the dielectric dispersion appear in the range 70–50% polymer, where the macroscopic viscosity has its most rapid rate of change with composition. A characteristic difference between free dipoles and dipolar polymers is pointed out: the former can assume a normal distribution of orientations, while the latter have a distribution determined by the chain orientation. For Part III see Abstract 1720 (1938).] AUTHOR.

See also Abstracts 4305, 4415 and

2299B. Dielectric Properties of Insulating Materials. E. J. Murphy and S. O. Morgan.
2300B. Power Losses in Liquid Dielectrics. L. Hartshorn and E. Rushton.
2303B. Dielectric Properties of Synthetic Resins. L. Hartshorn and E. Rushton with N. J. L. Megson.

ELECTROCHEMISTRY.

4384. Rôle of Electrons in the Production of E.M.F. at the Contact of Metal and Electrolyte. V. Karpen. *Comptes Rendus*, 209. *pp.* 474–476, *Sept.* 18, 1939.—In the theory here described metal and electrolyte in contact are considered as two non-miscible liquids of very different dielectric constants, containing kations of the metal in concentration M for the metal, M^1 for the electrolyte; free electrons of respective concentrations ϵ and ϵ^1, as well as metallic atoms. ϵ is considered nearly nM, n being the valency of the metal. The energy θ_m of an equivalent of kation in the interior of the metal is smaller than that, θ_e, in the electrolyte; the difference $\theta = \theta_e - \theta_m$ represents the work that must be expended to cause the equivalent of kation of the metal to pass into the electrolyte. When a metal is introduced into an electrolyte there is not only between these two media an exchange of kations, according to Nernst's theory, but also an exchange of electrons. The exchange of kations produces between metal and electrolyte, a p.d. V_1, determined by the relation of statistic equilibrium $V_1 = \theta - (RT/n) \log M/M^1$. The exchange of electrons gives rise to an analogous relation $V_2 = -\tau + RT \log \epsilon/\epsilon^1$. These values should be equal, but they are generally not so, and the statistical equilibrium supposed possible does not exist. The real potential is established at an intermediate value by a mechanism explained by the author. This theory of the p.d. of contact permits of taking account of the mechanism of functioning of all electrochemical batteries, as also of the cause of the super-tensions observed in electrolysis. J. J. S.

4385. Ionisation Constant of Water in 20, 45 and 70% Dioxane-Water Mixtures. H. S. Harned and L. D. Fallon. *Am. Chem. Soc., J.* 61. *pp.* 2374–2377, *Sept.*, 1939.—From measurements of the cells, H_2 | NaOH (m_1), NaCl (m_2), dioxane (X), H_2O (Y) | AgCl-Ag, the ionisation constant of water has been determined in 20, 45 and 70% dioxane mixtures, and at 5° intervals from 0 to 50° inclusive. The heat content and heat capacity changes of the ionisation reaction have been evaluated. The uncertainty in the determination of the ionisation constant increases with the dioxane content of the solvent. This is caused by the change in relative solubility of silver chloride and hydroxide and cannot be remedied as long as silver-silver chloride electrodes are employed. Cells containing silver-silver bromide or iodide electrodes would probably be more suitable, but, unfortunately, their standard potentials are not known in these media. [See Abstract 1810 (1937) and following Abstract.] AUTHORS.

4386. Ionisation Constant of Acetic Acid in 82% Dioxane-Water Mixture. H. S. Harned and L. D. Fallon. *Am. Chem. Soc., J.* 61. *pp.* 2377–2379, *Sept.*, 1939.—From measurements of the cells H_2 | HAc (m_1), NaAc (m_2), NaCl (m_3), dioxane (X), H_2O (Y) | AgCl–Ag, the ionisation constant of acetic acid has been determined from 5 to 45° in a solvent containing 82% by weight of dioxane, the dielectric constant of which is 9·3 at 25°. The principal source of error in this determination is caused by the uncertainty in the determination of the standard potential, E_0. The results indicate a maximum in the ionisation constant which occurs at 15°. Log K does not vary linearly with the reciprocal of the dielectric constant. The plot of log K *versus* the mole fraction of dioxane at a given temperature is nearly linear. Numerical equations expressing this linear relationship have been constructed and a table of deviations compiled from which K may be evaluated in all solvents containing 0 to 82% dioxane and at 5° intervals from 0 to 50° with an accuracy comparable to the experimental error. [See preceding Abstract.] AUTHORS.

***4387. Lead-Iodine Voltaic Cell. W. C. Vosburgh and V. H. Dibeler.** *Am. Chem. Soc., J.* 61. *pp.* 2522–2523, *Sept.*, 1939.—The cell Pb(Hg)/PbI_2, $PbClO_4$(m),/$PbClO_4$(m), PbI_2, I_2/(Pt) has been found to be easily reproducible and to remain constant in e.m.f. over periods of at least several months. It recovers its original e.m.f. after charge or discharge more quickly than the Weston cell. AUTHORS.

4388. Electrolytic Polishing. W. C. Elmore. *J. of Applied Physics*, 10. *pp.* 724–727, *Oct.*, 1939.—An investigation of the electrolytic polishing of copper by the Jacquet method has thrown new light on the mechanism responsible for the polishing action. From a study of the voltage-current curves it is concluded that when conditions are right for polishing the concentration of dissolved Cu at the anode is the highest possible. Accordingly the concentration gradient which exists at the anode limits the rate at which Cu can dissolve, *i.e.*, diffuse into the bulk of the electrolyte (orthophosphoric acid). Since there is greater diffusion from raised areas of the anode because of steeper concentration gradients near them, the surface will become progressively more nearly level. The surface does not etch for the concentration gradient alone controls the rate of solution. Details are given for the electrolytic polishing of iron with an orthophosphoric acid electrolyte. A convenient form of cell for electrolytic polishing is described. [See Abstract 3258 (1937).] AUTHOR.

See also Abstract 4232 and

2294B. Rapid Chemical Analysis with the Mercury Dropping Electrode and an Oscillograph or Measuring Bridge as Indicator. J. Boeke and H. van Suchtelen.

2296B. Gravimetric Study of Lead Accumulators. E. Denina.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

4389. Electron in Classical General Relativity Theory. A. Lees. *Phil. Mag.* 28. *pp.* 385–395, *Oct.*, 1939.—The difficulties associated with the point electron in general relativity are avoided by ascribing to the electron a definite surface, for which a consistent scheme of stresses and electromagnetic properties is formulated. The external properties of the electron are preserved unchanged.

4390. Non-Additivity in Scattering Cross-Sections of Slow Neutrons. M. Kimura. *Imp. Acad. Tokyo, Proc.* 15. *pp.* 214–216, *July*, 1939. *In English.*—The back scattering of a canalised beam of slow neutrons was measured for Hg, S, and HgS. With group C neutrons the scattering cross-section for Hg was too small to be measured, for S it was about 1×10^{-24} cm^2., and for HgS it was greater than 30×10^{-24} cm^2., revealing a remarkable non-additive effect. For group D neutrons the additive law held within experimental error. W. E. D.

4391. Elastic Collisions of Protons and Neutrons. M. Nogami. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 917. *pp.* 244–250, *Aug.*, 1939. *In English.*—The angular distributions and elastic cross-sections are calculated for very fast neutrons. For neutron energies 15, 25, 30, 35 emV respectively, the elastic cross-section in 10^{-24} cm^2. is $0{\cdot}6_5$, $0{\cdot}3_8$, $0{\cdot}3_0$, $0{\cdot}2_5$ respectively. Recent experimental work confirms the results. [See Salant, Roberts and Wang, *Phys. Rev.* 55. *pp.* 984–985, *May* 15, 1939.] E. E. W.

4392. Determination of Inner Potential by Electron Reflection Method. T. Yamaguti. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 375–380, *July*, 1939. *In English.*—A zincblende crystal was split into two approximately equal parts along a cleavage plane, and the two placed side by side, the surface of one of the planes having been etched. Parallel electron beams of the same energy fell on each crystal, and the resulting reflected patterns examined. From the pattern obtained from the etched surface the value of $\lambda/2d$ was obtained, and using this value the inner potential could be determined from the clean cleaved surface pattern. The value of the inner potential obtained by this method rose rapidly from $4{\cdot}59 \pm 0{\cdot}13$ V for the first order to $12{\cdot}00 \pm 0{\cdot}09$ V for the third order and then more slowly to $12{\cdot}41 \pm 0{\cdot}10$ V for the sixth order. The lack of saturation indicates a small error in the author's extrapolation method used previously. W. E. D.

4393. Numerical Calculations of Reflection of Electrons by Metals. L. A. MacColl. *Phys. Rev.* 56. *pp.* 699–702, *Oct.* 1, 1939.—The specular reflection of electrons by metallic surfaces is considered. It is assumed that the potential energy of an electron is constant $(= -V_0)$ in the interior of the metal, and account is taken of the image force acting on an electron outside the metal (Nordheim's problem). The reflection coefficient R is computed for the range of values of V_0 which is of interest in connection with real metals, and for the range of values of energy of the electrons in which R has appreciable values. In the Appendix there are given some values of the function $\Gamma'(iy)/\Gamma(iy)$, for real values of y, which were computed incidentally. AUTHOR.

4394. Theory of Secondary Emission. D. E. Wooldridge. *Phys. Rev.* 56. *pp.* 562–578, *Sept.* 15, 1939.—The production of secondary emission by the interaction of bombarding electrons with the valence electrons of a metal target is quantum-mechanically treated. When the results are modified by considerations having to do with the relative rates of absorption of the primary and secondary particles, yield-*vs.*-bombarding energy curves are obtained which approximate the results of experiment. The primary voltage required for maximum yield, the effect of work function on the emission, and the energy range of the secondary particles are semi-quantitatively derived in terms of the properties of the target material. AUTHOR.

4395. Secondary Electron Emission. Part VI. J. H. de Boer and H. Bruining. *Physica,* 6. *pp.* 941–950, *Oct.,* 1939. *In English.*—When a metal surface is gradually covered with atoms of an electropositive metal (Ba on Mo), the secondary and photoelectric emission both pass through a maximum at the same degree of covering (($\sigma = \sigma_m$). From this it may be concluded that the rise of the secondary emission is caused by the decrease of the work function. The secondary emission is a linear function of σ, with small degree of covering ($\sigma \ll \sigma_m$); the photoelectric emission is an exponential function of σ (irradiation with white visible light). This difference is caused by the fact that the energy of the escaping secondary electrons is much greater than that of the photoelectrons. It is shown, that a selective secondary emission from the adsorbed atoms might be observable with slowly moving primary electrons. [For Parts IV and V see Abstract 3793 (1939).] AUTHORS.

*4396. **Electron Supermicroscope for Research Institutes. B. v. Borries and E. Ruska.** *Naturwiss.* 27. *pp.* 577–582, *Aug.* 25, 1939.—An electron super-microscope suitable for research institutes is described. The technique of operating it is fully considered, and some of its applications are mentioned. A. J. M.

*4397. **Resolving Power of Supermicroscope. B. v. Borries and E. Ruska.** *Zeits. f. techn. Physik,* 20. 8. *pp.* 225–235, 1939.—The effect of spherical and chromatic aberration and of diffraction on the resolving power of an electron microscope is discussed. The resolving limit of an electron microscope employing magnetic lenses may reach 5 mμ for 70 kV electrons and tends to decrease as the accelerating potential is increased. H. J. H. S.

*4398. **Single Crystal Fluorescent Screens for Supermicroscopy. M. v. Ardenne.** *Zeits. f. techn. Physik,* 20. 8. *pp.* 235–239, 1939.—Fluorescent screens consisting of single crystals of activated ZnS are described for use with u.v. and electron microscopes. The R.P. of such screens is greater than the usual type of screen consisting of a polycrystalline aggregate and there is a considerable gain in intensity. Images formed on this screen may consequently be magnified optically to a greater degree. H. J. H. S.

4399. Possibility of Examining Living Substances with Electron Microscope. M. v. Ardenne. *Zeits. f. techn. Physik,* 20. 8. *pp.* 239–242, 1939.—If a living micro-organism is to be examined with the electron microscope, it must be able to withstand vacuum conditions and electron irradiation. The amount of energy which must fall on the organism in order to give rise to a photographable image is calculated approximately, whilst the sensitivity of living organisms to such an energy loading is discussed. The comparative merits of the ordinary and of the raster electron miscroscope for this purpose are described. H. J. H. S.

4400. Limiting Current Densities in Electron Beams. J. R. Pierce. *J. of Applied Physics,* 10. *pp.* 715–724, *Oct.,* 1939.—In electron beam devices the thermal velocities of the electrons leaving the kathode limit the current density which can be attained with given kathode current density, kathode temperature, potential, and angular spread of arriving electrons. By using Liouville's theorem, limiting expressions are obtained which are valid for any point focus or line focus concentrating system using steady electric and magnetic fields. Current densities in perfectly focused beams are also evaluated. Curves are presented which relate the nearness of approach to the maximum attainable current density with the fraction of kathode current necessarily lost in the concentrating system. Use of the expressions obtained is illustrated by applying them to kathode-ray tubes and electron multipliers. AUTHOR.

See also Abstract

2334B. Cold Kathode-Ray Oscillograph for Very Low Voltages. H. Thielen.

ELECTROSTATICS.

See Abstracts 4384, 4422 and

2298B. H.V. Production by Currents of Electrified Particles. M. Pauthenier.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

4401. Influence of Strong Magnetic Fields on Resistance of Mo Single Crystals. A. Foroud and E. Justi. *Phys. Zeits.* 40. *pp.* 501–506, *Aug.* 1, 1939.—Measurements are made of the electrical resistance of a single crystal of Mo over the temperature range 4·2° to 373° K. in the presence of strong external magnetic fields to ascertain whether Mo gives similar results to W [see Abstract 305 (1938)]. This expectation is fulfilled in that there is anisotropy of resistance in the magnetic field, the anisotropy factor is independent of the field strength, the resistance undergoes similar increases for both directions of the field up to 35000 G, and that the Kohler rule [see Abstract 1322 (1938)] is obeyed, the resistance increase being independent of temperature and simply a function of the ratio of the field strength to the resistance prior to the application of the field. The field-free resistance of Mo is a function of T^2 at temperatures below 20° K. The results indicate a characteristic temperature of 384°. The temperature coefficient between 0° and 100° C. amounts to an increase of 0·471% per °C. R. W. P.

MAGNETISM AND ELECTROMAGNETISM.

4402. Magnetic Susceptibilities of Metallic Oxides, Especially of Cr and Mn. S. S. Bhatnagar, A. Cameron, E. H. Harbard, P. L. Kapur, A. King and B. Prakash. *Chem. Soc., J. pp.* 1433–1441, *Sept.*, 1939.—Different workers report widely divergent results for the magnetic susceptibilities of the transition metals. It has now been shown that, if the best values for the susceptibility are taken, the magnetic moment, as calculated from the Curie law, gives values which are of no theoretical significance, but application of Weiss's modification of this law to the oxides of Cr and Mn gives values for the magnetic moment which are in accord with theory and enable magnetic measurements to be used for the evaluation of the correct formulæ of oxides. The formulæ of the oxides of Mn are discussed, and the occurrence of quadrivalent Cr in a hydrated dioxide of that metal established. The magnetic susceptibility of the various stages of decomposition of chromium trioxide has been measured, and it has been found that there is little change in the magnetic susceptibility with variation of composition in non-stoicheiometric oxides. The Cr_5O_9 non-stoicheiometric oxide is ferromagnetic. Samples of chromic oxide prepared by different methods have slightly different susceptibility values. It is suggested that these differences are due to the presence of impurities and, in particular, to small amounts of chemisorbed gaseous elements. The adsorption of O_2 or of H_2 at 440° on this oxide causes definite variation in the susceptibility value. High-temperature evacuation likewise causes a considerable fall in the susceptibility of chromic oxide. It is suggested that activated adsorption on oxides is connected with reduction of chemisorbed oxygen, and the use of magnetic measurements is recommended as a means of following surface chemical processes on oxides. AUTHORS.

4403. Exchange Interaction in Magnetic Crystals. W. Opechowski. *Physica*, 6. *p.* 1112, *Oct.*, 1939. *In English.*—Corrections to the original [see Abstract 1826 (1937)].

4404. Effect of Mechanical Strain on Ferromagnetic Properties. H. Schlechtweg. *Ann. d. Physik*, 35. 7. *pp.* 657–664, *Aug.*, 1939.—The alteration in the exchange energy as a result of deformation of a crystal lattice leads to local modifications of the energy associated with the region between two elementary domains. This is shown to result in a contribution to the critical field strength of the Barkhausen effect which is independent of the magnetostriction and crystal anisotropy. H. J. H. S.

***4405. Apparatus for Detection of Magnetic Materials. J. S. Johnson and G. S. Field.** *Canad. J. of Research*, 17. *Sect. A. pp.* 194–195, *Sept.*, 1939.—An apparatus for the detection of magnetic materials is described which operates on continuous d.c. instead of a.c. or interrupted d.c., as has been the case with previous detectors. This apparatus is highly sensitive and requires very little adjustment. Once installed it can be operated by a non-technician. AUTHORS.

***4406. Coils for Production of Uniform Magnetic Field. R. H. Lyddane and A. E. Ruark.** *Rev. Sci. Instruments*, 10. *pp.* 253–257, *Sept.*, 1939.—Extending work by Harris, [see Abstract 4351 (1934)], the authors show how to produce a highly uniform magnetic field in a rectangular box, long compared with its cross-section, by using a pair of rectangular coils placed on opposite sides of the box. If the width of each coil is 3½ times the distance between them, the region in which the field deviates less than 1% from the value at the centre is about nine times larger than that obtained with previous coils having other width-distance ratios. The use of square wire-bundles causes the main correction terms depending on finite cross-section to vanish. The homogeneity achieved compares favourably with that obtainable by Helmholtz coils. AUTHORS.

See also Abstracts 4225, 4272, 4273, 4375 and
2350B. Experiment on Electromagnetic Induction by Linear Motion. E. G. Cullwick.

MEDICAL RADIOLOGY AND ELECTROLOGY.

4407. Steady Potential of Human Eye in Subjects with Unilateral Enucleation. W. R. Miles. *Nat. Acad. Sci., Proc.* 25. *pp.* 349–358, *July*, 1939.—Measurements of eye-potential are made on nine people with unilateral enucleations, including both males and females of widely varying ages, by a method previously described [see Abstract 3038 (1939)]. Potentials for the single active eye correspond closely with the comparable values found for normal two-eyed people. The individual eye when turned 30° right or left from the primary line of regard registers an average potential of about 0·7 mV. Enucleates agree with normals in showing larger potentials when the eyes are directed upward than when directed downward an equal amount; this difference, characteristic in adults, is reversed in children of 10 to 12 years. In most cases the region about the artificial eye of an enucleate shows quite small potentials. The bitemporal lead for enucleates gives a very different result from that for two-eyed people;

right and left deviations do not give the same potential and the registered value is much less than for the one active eye. There are marked individual differences in the spread of electrification to adjoining tissues from the active eye of enucleates or from each of a pair of eyes. J. E. K.

4408. Quantum-Mechanical Attraction and Problem of Immunity Reactions. P. Jordan. *Zeits. f. Physik*, 113. 7–8. *pp*. 431–438, 1939.– The empirical facts concerning " active groups " of immunising effective " antigens " are reviewed, for the purpose of testing the question, whether the quantum-mechanical " resonance attraction " is applicable to the explanation of the serological reactions. [See Abstract 850 (1939).] T. A. C.

4409. Analysis of Skin Pigment Changes After Exposure to Sunlight. E. A. Edwards and S. Q. Duntley. *Science*, 90. *pp*. 235–237, *Sept*., 1939.—Using the Hardy recording spectrophotometer [see Abstract 4217 (1935)] the pigmentary changes in human skin have been determined objectively after 1 hr. exposure to sunlight. Curves are given showing the percentage reflectance plotted against wave-length in mμ. Carotene is evidenced by the absorption bands at 482 mμ and melanin is moderate in amount, as shown by the upward slope from 400–700 mμ. The degeneration of melanin produces an allied pigment, which the authors have named melanoid, the presence of which is made evident by a flattening of the curve near 400 mμ. Hyperæmia (oxyhæmoglobin) is maximal at 11 hr., melanin at 19 days and melanoid at 4 mths. Blood stagnation as registered by reduced hæmoglobin, persists from the time of the early disappearance of hyperæmia for over 9 mths. From the purely physical data represented by the spectrophotometric curves, the psychophysical specification of the colour stimulus received by the eye of a normal observer was computed for I.C.I. Illuminant C using data standardised by the International Commission on Illumination in 1931 [see Abstract 4867 (1933)]. T. A. C.

4410. Separate and Combined Action of Short- and Long-Wave U.V. Radiation on Human Skin. I. Hausser. *Naturwiss*. 27. *pp*. 563–566, *Aug*. 18, 1939.—With regard to the human skin the short-wave u.v. spectrum—about 298 mμ—has a marked erythema-producing action, and the longer u.v.—about 385 mμ—has a marked pigment-forming action. Details of the effects obtained by these two spectral regions either individually or jointly are given. It is found that the erythema part of the effect can be made to disappear by the exercise of pressure. G. G.

4411. Developmental Effects Resulting from Exposure to X-Rays. Part I. R. Rugh. *Am. Phil. Soc., Proc*. 81. 3. *pp*. 447–471, 1939.—Uniform suspensions of sperm from hibernating frogs, *Rana pipiens*, were irradiated with X-rays at 200 kV from 15 *r* to 50000 *r* prior to using them for artificially inseminating frog's eggs. No effect on motility or fertilising powers of sperm was detected; nor on rate or pattern of early cleavages. Even at 15 *r* some resulting embryos showed exogastrulation and spina bifida while at 1,000 *r* some perfectly normal embryos resulted. This discrepancy is explained as a result of chance bombardment of vital points in chromosomes, since at higher doses all resulting embryos are abnormal. If hatching is considered as a critical end-point, there is a typical exponential curve of hatching percentage dropping from

97·8% at 15 *r* to 1·6% at 10000 *r* and rising again to 90·5% at 50000 *r*. This latter rise is explained as due to incapacitating of sperm for syngamy but not for activation of the egg ; hence gynogenetic development follows. Such abnormalities as are produced have been produced by other means such as subjecting the developing embryo to drastic environmental changes. Here the effect is applied through the sperm by irradiation prior to insemination of normal eggs. Preliminary tests indicate disruption of chromosomes, and therefore the effect is described as due to induced lethal mutations. These experiments are foundation for further research along the lines of wave-length effect ; chromosome effect ; tissue culture and transplantation studies. AUTHOR.

4412. Neutrons and Radio-Elements and Their Biological Applications. *Nature*, 144. *pp*. 657–658, *Oct*. 14, 1939.

***4413. Radium Exposure Meter. L. F. Curtiss.** *Bureau of Standards, J. of Research*, 23. *pp*. 479–484, *Oct*., 1939.—The meter for radium exposure described in this article is a modification of a portable Geiger-Müller counter unit with a range of sensitivity that is suitable for indicating when the tolerance dosage for γ-ray exposure has been exceeded. A milliammeter indicates the actual exposure in roentgens per day, and a light and buzzer are energised when the exposure exceeds the equivalent of 0·1 roentgen per day. This alarm arrangement is particularly important in handling Ra, since it reveals at once when the safe limits of exposure have been exceeded. It has been found of help in ascertaining the effectiveness of lead screening arrangements and storage safes. Where large quantities of radium are in constant use, unsafe conditions may frequently pass unnoticed for a considerable time in the absence of some provision for their detection. This device is of great help in training technicians to follow safety procedures by warning them immediately of unsafe conditions, as far as general exposure is concerned. The device works from a single a.c. outlet and will operate continuously. It may be transferred readily to any location where a test of exposure is desired. AUTHOR.

See also Abstract 4399.

OSCILLATIONS AND WAVES.

***4414. Frequency Measurement with High Accuracy. H. O. Kneser and H. Knötzel.** *Zeits. f. techn. Physik*, 20. 8. *pp*. 242–244, 1939. —An equipment is described by which frequencies in the range 0·3 to 1500 kc./sec. may be measured with an accuracy of 1 part in 10^4. A generator of range 0·28 to 18 kc./sec. is adjusted so that its fundamental or harmonic frequency is in synchronism with the incoming signal. The scale of the generator is calibrated at a number of points by reference to a quartz-controlled oscillator the unknown frequency then being determined by interpolation on the generator scale. L. E.

***4415. Absorption and Refraction of 0·2–0·5 mm. Waves in Dielectrics and Oxides. O. Maar.** *Zeits. f. Physik*, 113. 7–8. *pp*. 415–430, 1939.—An apparatus is described by which the transmission of radiation of 200 to 500 μ is measured. The intensities of the radiation, which is obtained from a Hg arc, are determined by means of a spectrometer and a suitable radiometer. The transmission of six different dielectrics are measured, including Al_2O_3, Be O, " Tempa S," " Galit," " Trolitul " and ebonite. The absorption coefficients and refractive indices are calculated and shown as a function of the wave-length. A. M. T.

4416. Parabolic Wire-Reflectors for 3 m. Waves. A. K. Dutta, M. K. Chakravarty and S. R. Khastgir. *Indian Journ. Phys.* 13. *pp.* 167–184, *June*, 1939.—The paper presents the results of an experimental study of parasitic wire-reflectors arranged in a parabolic array on a wave-length of about 3 m. The array had a focal length of $\lambda/4$ and the length of the wire-reflectors was $\lambda/2$. The primary aerial which was a grounded vertical λ-4/aerial connected to an ultra-short transmitter was placed at the focus of the parabola and the waves were received by a heterodyne receiving set constructed for the purpose. The relative field-strengths at a definite distance from the primary aerial were then measured for different orientations of the parabolic reflector. The polar distribution of the field-strengths was in this way studied: (1) with *varying* numbers of the wire-reflectors in the array with a *fixed* spacing between the contiguous wires, (2) with a *fixed* number of wire-reflectors of *varying* spacing values, and (3) with a *constant* value of the aperture for the parabolic array of *varying* numbers of wire-reflectors. The experimental study yielded information about the dependence of *forward radiation, total directivity, forward-sector directivity* and *back radiation* on the number, spacing and aperture of the parasitic reflectors in the parabolic array. A theoretical discussion of the experimental results is also given in the paper. AUTHORS.

4417. Reflection and Transmission of a Finite Wave-Train in a Laminated Medium. Y. Nomura. *Phys. Math. Soc. Japan, Proc.* 21. *pp.* 339–346, *June*, 1939. *In English.*—As a preliminary, the problem of an infinite wave train incident on a medium consisting of *n* layers of material of differing dielectric constant is treated, and the intensities of the transmitted and reflected waves calculated. The allied problem of a train of finite length is then dealt with, and formulæ for the intensities again worked out. Finally the result is applied to the case of a single layer whose dielectric constant is 2·25, embedded in a medium of dielectric constant 1·0. The variation of the ratio of reflected to transmitted intensity is shown in curves as a function of the thickness of the layer. J. P. A.

4418. Sun and Ionosphere. Parts I and II. W. Grotrian. *Naturwiss.* 27. *pp.* 555–563, *Aug.* 18, *and pp.* 569–577, *Aug.* 25, 1939.—The object of this paper is to review the data concerning the ionosphere from the point of view of the astrophysicist. After a brief account of the methods of measuring the height of the ionospheric layers, the daily and yearly changes in these heights are considered. These changes are related to the production of ions by means of solar radiation. The splitting of the F-layer into two layers during the summer months and its continued existence during the night can be explained by the slower recombination of electrons and ions at its greater height. Decisive results on the effect of solar radiation were obtained during the eclipse of 31 Aug., 1932. The changes in the ionisation in rhythm with the 11-year sunspot period are also discussed. S. K. Mitra's explanation of the production of the different layers by different modes of ionisation—F_2 by ionisation of O, F_1 by ionisation of N_2 and E by ionisation of O_2—is described. The significance of the u.v. excess, the phenomenon of granulation, and the question as to whether the solar radiation is corpuscular or not is considered. In Part II the Dellinger effect, *i.e.*, the disappearance or "fade out" of short-wave transmission during solar eruptions is described and discussed, as well as the occurrence of magnetic storms at such moments. The classical experiments of Carrington are cited. Many astrophysical details are given and it is concluded that these data exclude the possibility of the solar radiation being corpuscular. Many details concerning the structure of the ionospheric layers during such a fade-out are given. The effects of the corpuscular radiation associated with the polar lights are described and considered; the nature of this form of radiation is also discussed. Finally the so-called " abnormal E-layer " is mentioned. G. G.

4419. Ionospheric Effects Associated with Magnetic Disturbances. L. V. Berkner, H. W. Wells and S. L. Seaton. *Terr. Mag.* 44. *pp.* 283–311, *Sept.*, 1939.—Automatic multifrequency ionospheric records are discussed with the object of elucidating the nature of ionospheric changes coincident with magnetic activity in the temperate and equatorial zones. Observations at Kensington (Maryland) during the summer are described and illustrated. Discussion of the results shows that there is evidence of considerable turbulence in the F-region during magnetic disturbances. Winter and summer night conditions are found to be similar. Moderate magnetic disturbances during the day in winter appear to produce little effect in the ionosphere, which recovers rapidly to nearly normal conditions after daylight. A special study is made of the severe magnetic disturbance of April 16, 1938, in connection with equatorial-zone ionospheric disturbances. During this storm very large and surprising variations of electron density were observed in the F-region, the density twice falling practically to zero. Reference is also made to the dependence of observed changes of radio transmission on the observed ionospheric effects. A. W.

4420. Non-Seasonal Behaviour of the F-Region. S. L. Seaton and L. V. Berkner. *Terr. Mag.* 44. *pp.* 313–319, *Sept.*, 1939.—Non-seasonal variation in maximum electron-density of the F-region previously discussed using observations at noon of critical frequency at Washington (39° north), Watheroo (30° south), and Huancayo (12° south) is further examined using data for all 24 hours of the day. The effect of averaging over all hours is to reduce the seasonal variation much more than the non-seasonal variation, so that variation of monthly mean electron-density is substantially identical at all three stations. The reality of this result has been tested statistically. Harmonic analyses of the monthly mean maximum electron-density averaged over all hours shows, after removing secular change associated with solar activity, a first harmonic of 9·3 (Mc./sec.)^2 with maximum in January and a second harmonic of amplitude 7·4 (Mc./sec.)^2 with maxima in April and October. These values are averages for the three stations. The mean correlation-coefficient between pairs of stations is 0·87. The fact that the seasonal variation of period 12 months is relatively much smaller than that present in data at noon suggests that the seasonal variation in these data is principally a variation in amplitude of diurnal variation. AUTHORS.

***4421. Dynamic Valve Test Set. K. A. Macfadyen and B. L. Day.** *Journ. Sci. Instruments*, 16. *pp.* 324–331, *Oct.*, 1939.—The test set described is designed for investigating the characteristics of medium and large amplifying, modulating and transmitting valves. The chief advantages are simplicity and accuracy, with safety for the operator. AUTHORS.

4422. Distribution of Potential in Cylindrical Thermionic Valves. J. Crank, D. R. Hartree, J. Ingham and R. W. Sloane. *Phys. Soc., Proc.* 51. *pp.* 952–971, *Nov.,* 1939.—This paper presents a derivation of the steady-state potential distribution in a space bounded by coaxial cylinders, between which a homogeneous electron current flows. The problem is not formally soluble, but the solution is represented by 24 particular solutions covering the whole range of values of the variables likely to occur in practice. The potential equation, derived through the equation of motion of an electron, is reduced to a non-dimensional second-order form. The complete solution of this is obtainable by evaluating a singly infinite set of solutions, as the independent variable has an arbitrary zero. The physical meaning of this form of solution is expressed in similarity theorems. The behaviour of the solution in limiting cases, and the approximate graphical solution of the first-order form, suggested the procedure adopted in solving the second-order equation, which was suitable for integration by means of the differential analyser. In some solutions, a singularity in the potential equation was avoided by numerical integration of the equation of motion, to give initial conditions for the mechanical integration away from the singularity. The solutions are tabulated. Some applications of the results to thermionic valve problems are illustrated by numerical examples. AUTHORS.

See also Abstracts 4271 and

2427B. Study of Ionosphere and Propagation of H.F. Radio Waves. K. Maeda.

PHOTOELECTRICITY.

See Abstracts 4315, 4318, 4319.

PIEZOELECTRICITY.

4423. Piezoelectric Potassium Phosphate. W. Lüdy. *Zeits. f. Physik,* 113. 5–6. *pp.* 302–305, 1939.—The piezoelectric modulus d_{36} of KH_2PO_4 crystals is measured statically in dependence on temperature. At 10° C. the modulus is of the same order as for the quartz but in the neighbourhood of the " Rochelle-electric " Curie point of the crystal it increases greatly and reaches a maximum at 123° Abs. which exceeds the value at 10° C. by a factor of over 5000. J. E. K.

THERMIONICS.

4424. Evidence of Periodic Deviation from Schottky Line. Part I. R. L. E. Seifert and T. E. Phipps. Part II. D. Turnbull and T. E. Phipps. *Phys. Rev.* 56. *pp.* 652–667, *Oct.* 1, 1939.—A periodic deviation from the Schottky line has been observed for W and for Ta. For fields less than 4×10^4 V cm^{-1}. the deviations are of the order of the experimental error. For fields greater than this the sign and magnitude of the peak deviations may be seen from the following series, the first number in each case being the value of $E^{\frac{1}{2}}$ in volt$^{\frac{1}{2}}$ cm$^{-\frac{1}{2}}$, and the second being the percent deviation from a least-squares reference line: 200, $+0{\cdot}03(\pm 0{\cdot}01)$; 265, $-0{\cdot}07(\pm 0{\cdot}01)$; 365, $+0{\cdot}12(\pm 0{\cdot}01)$; 501, $-0{\cdot}11(\pm 0{\cdot}01)$. The data refer to a 1-mil W wire at 1610° K. There is no appreciable effect of temperature upon the positions of the peaks along the $E^{\frac{1}{2}}$ axis. The magnitude of the deviations decreases with increasing temperature. The results with Ta agree within experimental error with those for W. In Part II the periodic deviation from the Schottky line observed above was studied in greater detail for W up to fields of $6\cdot5 \times 10^5$ cm^{-1}. The deviation continued with increasing period and amplitude up to the highest fields investigated. The characteristic Schottky distance from the surface, x_0, was calculated for all values of the field at which maximal and minimal values of the deviation occurred. The difference between successive x_0 values was of the order 24A between $E^{\frac{1}{2}} = 160$ and $E^{\frac{1}{2}} = 266$; of the order 17A between $E^{\frac{1}{2}} = 266$ and $E^{\frac{1}{2}} = 505$; and of the order 12A between $E^{\frac{1}{2}} = 505$ and $E^{\frac{1}{2}} = 752$. The temperature coefficient of the position of these maximal and minimal values along the $E^{\frac{1}{2}}$ axis, $dE_m^{\frac{1}{2}}/(E_m^{\frac{1}{2}}dT)$, if it exists at all, is less than $5\cdot9 \times 10^{-5}$ deg^{-1}. [See following Abstract.] AUTHORS.

4425. Periodic Deviation from Schottky Line. H. M. Mott-Smith. *Phys. Rev.* 56. *pp.* 668–669, *Oct.* 1, 1939.—The width of the potential hump traversed by thermions moving between parallel plates depends upon the strength E of the external field at the kathode. Partial reflection at this hump, analogous to the partial reflection of light passing through a thin plate, may account for the small deviations from the Schottky line, depending in a periodic manner on $\sqrt{E}$, observed by Phipps, Seifert and Turnbull [see preceding Abstract]. A calculation based on this analogy shows rough agreement between the theory and the data. An approximate solution of the wave equation yields a small term of suitable period, but to start the theory, one needs a really accurate solution probably best obtained by mechanical integration. AUTHOR.

See also Abstract 4422.